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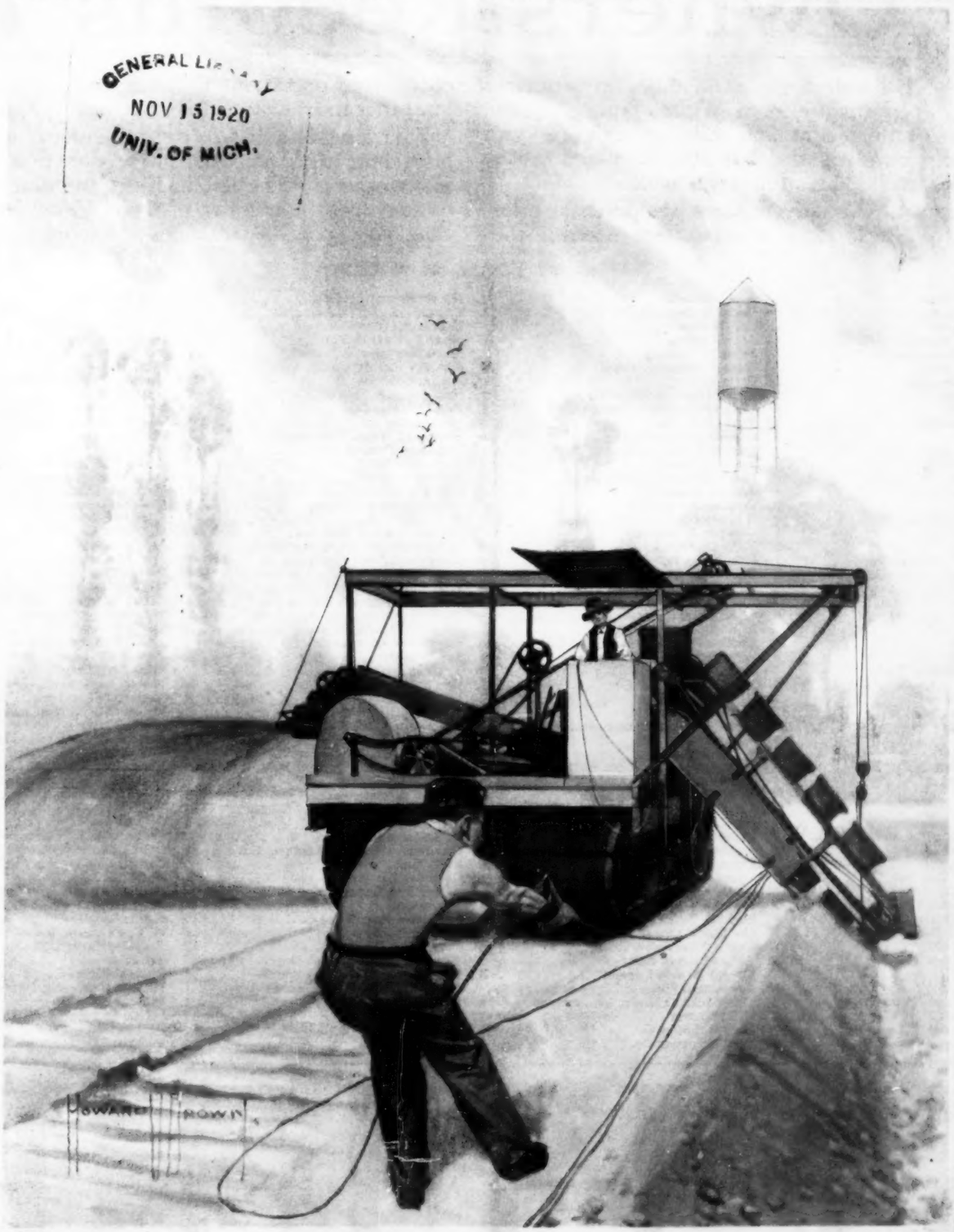
THE STATE AND THE FARMER
SOLVING THE LABOR PROBLEM

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



A CHAIN BUCKET MACHINE THAT DIGS, SHREDS AND SCATTERS PEAT.—[See page 496]

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FIRST *in* Owners' Records *of*

ONE hundred thousand miles is ordinary performance for a White Truck. Some have seen half a million miles of active service. Many have rounded out 200,000 and 300,000 miles, still doing a full day's work.

Spread over such mileages, the purchase price of a White Truck is a small item indeed in the cost of transportation. Earning power continues long after the investment is written off the books.

Following is a list of owners' records which have come to our attention. There are probably many others. The list includes the names of owners and the number of their White Trucks that have gone 100,000 miles and more.

100,000 TO 150,000 MILES

Abraham & Straus	4	R. E. Cobb Co.	1	Hardy Furniture Co.	2	A. J. McCarty	1
Acme Cash Stores	1	Cody Transportation Co.	1	Hansen Motor Trucking Co.	1	McCreery & Co.	1
Adams & Piggott	2	Cohen Bros.	1	Harris & Mowry Co.	1	Dorman McFaddin	1
Addison Auto Bus Co.	2	John Collins	1	Jesse B. Hart & Bro.	1	McMahon Brothers	1
Akers & Harpham Co.	2	John D. Coneau	1	Louis Hartman & Sons	1	McMahon Transportation Co.	6
R. T. Allen & Bros.	1	Conrad-Baisch-Kroehle Co.	2	Haverty Furniture Co.	3	R. A. McWhirr Co.	1
American Stores Co.	1	Criss Bros.	1	J. Clark Helms	1	Madary's Planing Mill, Inc.	1
S. M. Anderton	1	Crystal Spring Water Co.	1	Herrmann & Grace Co.	1	Mandel Bros.	14
Andre & Andre	1	Culmerville Auto Transit Co.	1	Hession, Florist	1	Marathon Auto Drayage Co.	1
Andrews & Horigan	1	W. J. Daly Co.	2	Higbee Co.	1	Marsh-Murdoch Coal Co.	1
Anthony Bros.	3	Davis Furniture Co.	1	Highland Motor Transfer Co.	1	The May Co.	1
John Arata & Son	1	Denver & Pueblo Construction Co.	1	Highway Transit Co.	1	May & Co.	1
Joseph R. Arbiter Co.	1	Frank J. Derry	1	R. A. Hilborn	1	Henry P. Mayer Music House	1
Atlantic Ice & Coal Corp.	15	Diamond Spring Brewery	1	Holder Coal Co.	1	John Meckes Sons Co.	2
Atlantic Refining Co.	5	August Doemling	1	Holm & Olson	1	Merchants Biscuit Co.	1
Christian Atz	1	Dorchester & Rose	1	Horstmeyer's Grocery	1	Mesaba Transportation Co.	6
Bakersfield Truck Co.	1	Downes Lumber Co.	1	M. L. Hullett	1	Michaud Bros., Inc.	3
A. L. Bartlett Co.	1	Duncan & Goodell	1	Hursen Undertaker, Inc.	1	Michigan Seating Co.	1
F. X. Baumert	1	F. B. DuPree	1	Independent School District No. 51	1	Julius Miske	1
Bekins Van & Storage Co.	1	Duquesne Transfer Co.	2	Interstate Auto & Supply Co.	1	J. E. Monahan	1
Benicia & Vallejo Stage Line	2	East Ohio Gas Co.	1	Interurban Auto Car Co.	1	Moore Transfer Co.	1
Bellevue & Allied Hospitals	1	T. Eaton Co., Ltd.	3	I. M. Iralson & Son	1	Moore-Handley Hardware Co.	1
Bergner Plumbing, Heat. & Sup. Co.	2	Chas. F. Eggers Lumber Co.	3	Jackson's Express & Van Co.	1	Henry Morgan & Co., Ltd.	1
Billow Undertaking Co.	3	C. R. Elder	1	W. K. Jeffries	1	Morrison-Skinner Co.	1
Block & Kuhl Co.	1	L. E. Elliott	1	Johnson Educator Food Co.	1	Motor Transit Co.	1
J. B. Blood Co.	1	Emerick's Motor Bus Line Co.	6	Johnson's Express Co.	1	Motor Transportation Co., Inc.	1
Louis H. Boice Co.	2	Emerson Piano House	1	Jones Store Co.	1	Mountain Auto Line	1
Booneville Bottling Works	1	Factory Oil Co.	2	J. G. Justis Co.	1	Timothy Murphy	1
Boston Fresh Tripe Co.	1	Marshall Field & Co.	7	Kee & Chapell Dairy Co.	2	Murta Appleton & Co.	1
Boston Furniture Co.	1	Field & Poorman	2	Edward Kelly	2	National Plumbing & Heat. Sup. Co.	2
Bradford Baking Co.	17	Fleming Bros.	1	Kelly-Springfield Tire Co.	1	National Shawmut Bank of Boston	1
Albert A. Brager	1	Florida Motor Transportation Co.	18	Kimberly-Clark Co.	1	Nelson Farm	1
Bra-Nola Co.	1	Flynn-Froelk Co.	1	George C. Kirkhope	1	New Bedford Dry Goods Co.	1
Geo. M. Brice	1	W. U. Fogwill	1	W. H. Kistler Stationery Co.	1	A. J. Norris	1
Eugene W. Bronecki	1	Fort Valley Coca Cola Bottling Co.	1	Knickerbocker Storage Co.	1	North St. Paul Casket Co.	1
Buffalo Plumbing Supply Co.	1	Alexander Fowler	1	Knoble Bros.	1	Norwich Motor & Machine Co.	1
Bullock's	5	R. J. Francis Moving Co.	2	P. C. Knowlton & Co.	1	Town of Norwood	1
City of Butte	1	Frank Franklin	1	G. W. Koehler Co.	1	V. G. Nottoli	1
W. L. Byrnes, Inc.	1	W. F. Frederick Piano Co.	2	Kohlberg Bros.	1	O'Neill & Co.	2
Caine-Grimshaw Co.	1	Fries & Schuele Co.	1	S. Kohn & Sons Co.	1	Orchard & Wilhelm	1
California Ice Co.	1	Fullington Auto Bus Co.	1	Kraus Heating & Plumbing Co.	1	Ott Hardware Company	1
Canton Provision Co.	1	Chas. Gaffney	4	J. S. Kroschewsky	1	Oxford Dye Works	1
H. C. Capwell Co., Inc.	2	Gazette Printing Co., Ltd.	1	Theodor Kundtz Co.	4	Pacific Baking Co.	1
Carbon Coal Co.	1	General Baking Co.	1	F. Landon Cartage Co.	1	Pacific Fruit & Produce Co.	2
J. B. Carr Biscuit Co.	1	Gifford's Express	1	S. Laskau	1	E. F. Pahl Co.	1
Carter-Mullaly Transfer Co.	1	Gimbel Bros.	25	Lee Bros. Furniture Co.	1	Palais Royal	1
M. Catalano & Sons	1	Goodyear Tire & Rubber Co.	2	E. Lehnhardt Estate	2	G. E. Patteson & Co.	1
Central Paper Co.	1	Grady Hospital	2	Lexington Dry Goods Co.	3	Pearson Paper Box Co.	1
Chandler & Rudd Co.	5	A. Graham & Son	2	City of Lincoln Police Dept.	1	Pelletier Co.	1
City Coal Co.	1	Grand Rapids Lumber Co.	1	City of Los Angeles Police Dept.	1	People's-Store Co.	2
City Ice Co.	1	Greenfield Electric Light & Power Co.	1	Los Angeles Gas & Elect. Corp.	1	Perkinswood Transportation Co.	1
City of Cleveland, Police Dept.	3	Greenfield Transfer Co.	1	Walter M. Lowney Co.	1	Perrett & Glenny	2
Cleveland Burial Case Co.	2	B. E. Grover	1	J. B. Lukens	1	Pierson Engineering & Constr. Co.	1
Cleveland Provision Co.	7	Gulf Refining Co.	1	E. B. McAlister & Co.	1	Postum Cereal Co.	1
Clover Leaf Dairy Co.	2	Fred Gunther Co.	1	Peter McCabe	2	Portland Damascus Milk Co.	1

WHITE

THE SCIENTIFIC AMERICAN, November 13, 1920. Volume 123, Number 20. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

Which of these salesmen will get in?

ANSWERING this question, a prominent buyer said, "Nowadays I must divide salesmen into two classes, first, those who call to get something, and second, those who come to contribute something. It is hard to turn away the latter kind who bring information and service helpful to me."

The word "Salesmanship" does not fully express the work that such men do. Their function is bigger than that.

The salesman who can contribute to the cause of fire prevention or the reduction of up-keep cost by skillful advice as to a properly constructed Johns-Manville Asbestos Roof is not a salesman only, for his work is more than commercial—it is economic.

The Johns-Manville man who can show a saving:—maybe thousands of dollars in fuel; a reduction in plant maintenance, or by preventing a shut down on a much needed boiler, makes the order he gets merely an incident to a greater purpose.

So, Johns-Manville waste killers have a real job. They must combine with a willingness to serve a wide experience and a thorough knowledge of those Johns-Manville materials which promote the cause of conservation everywhere by cutting fuel and power losses, preventing property losses and saving time and money.

It may be that some day a Johns-Manville man's card will come to your desk. Use the opportunity to let him show you how he can help you.

Let him tell you something of how his company serves and protects its customers. Let him explain how it has insured the quality of its products by the highest manufacturing standards, rigidly maintained, how it believes in its men and, because to you they are Johns-Manville, how it expects them to live up to its standards in all they do.

JOHNS MANVILLE SERVICE
COVERS THE CONTINENT

Through—

Asbestos

and its allied products

INSULATION
that keeps the heat where it belongs
CEMENTS
that make boiler walls leak-proof
ROOFINGS
that cut down fire risks
PACKINGS
that save power waste
LININGS
that make brakes safe
FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE
Serves in Conservation

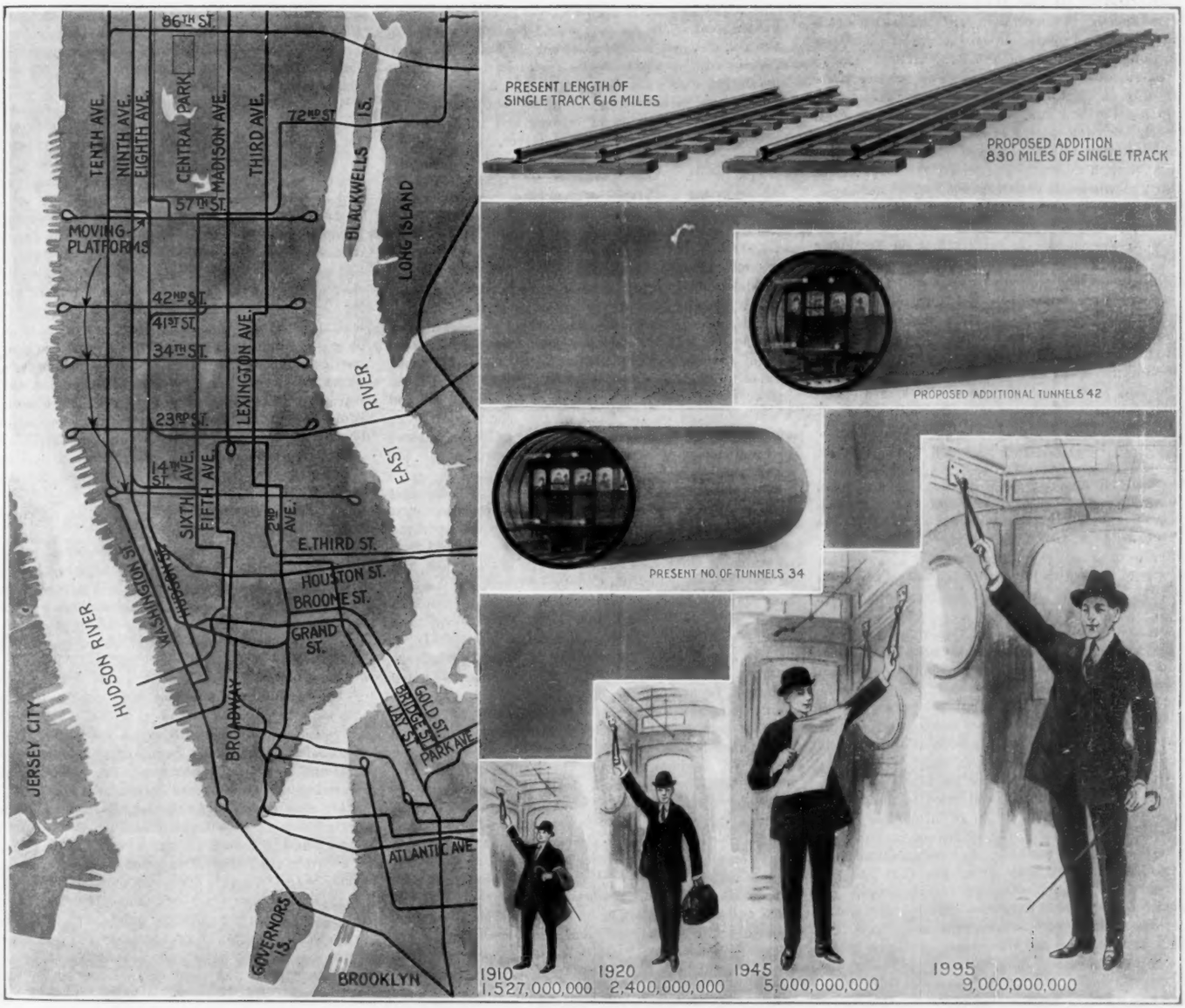
JOHNS-MANVILLE, Inc.
Madison Avenue, at 41st Street, New York City
10 Factories—Branches in 61 Large Cities
For Canada: CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto

SEVENTY-SIXTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 20] NEW YORK, NOVEMBER 13, 1920 [15 CENTS A COPY 20 CENTS IN CANADA



Map of lower Manhattan, showing in black lines the new subways which must be progressively built, in addition to the existing subways (not shown on map) if we are to keep pace with the growth of travel during the next 75 years. The construction to cover the needs of the next 25 years includes four tracks of a double deck, 8-track subway under Eighth Avenue, four tracks of a 6-track subway under Madison Avenue, crosstown moving platforms under 14th, 42d and 57th Streets, and additional tunnels under the East River at Ann Street, Maiden Lane, The Battery and 23d Street and the Narrows. The trunk lines on Third, Ninth and Tenth Avenues, with their branches, and the additional tunnels to Brooklyn, Staten Island and Jersey City, with numerous extensions to the city line, will be completed in the period 1945 to 1995. The drawings to the right show the estimated future subway travel, in passengers per year, and the tracks and tunnels that must be built to meet it during the next 75 years.

ADDITIONAL RAPID TRANSIT LINES REQUIRED TO CARRY THE POPULATION OF NEW YORK IN 1995.—(See page 500)

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

In Justice to the War Department

IN considering the storm of criticism which broke upon the War Department on the eve of the recent election, the attitude of the SCIENTIFIC AMERICAN is of course strictly non-partisan. The subject interests us only on its technical side, and for the reason that during the war and at the armistice we dealt very freely with the matter of military equipment.

The charge that in the raising of our huge army and providing it with adequate equipment the Department was guilty of wholesale extravagance and wastefulness, we do not consider to be well-founded. Had our authorities possessed the prophetic vision of a Hebraic seer; had they been able to predict that on November 11th of the year following that upon which we declared war, the great German army would fall like a pack of cards; the scale upon which we enlisted our young men and provided the clothing, food, rifles, machine guns, field guns, heavy artillery, powder supplies and all the equipment and impedimenta of war, would have been extravagant and wasteful to the *nth* degree.

But lacking such prophetic vision, the War Department had to base its estimates upon the military conditions as they existed in the spring of 1917, when the enemy was at the very crest of his military achievement. What were those conditions? Servia was under his heel; Roumania, too. Russia had crumbled, and the whole defensive line of the Central Powers was intact and apparently unbreakable. Moreover, the most optimistic of the high commanding officers of our allies were agreed that the war would last through the season of 1919; while there were not a few who believed that the final blow could not be struck before 1920.

Are we now to blame the War Department because it acted in accordance with the existing conditions and planned for recruitment and supplies upon a scale proportionate to the immensity of the undertaking? And yet this is exactly what the recent critics of the War Department have been doing; and, in our opinion, the whole proceeding has been as unjust as it has been ungenerous.

True it is that at the armistice we found ourselves with enormous plants for the production of guns, powder, et cetera, that were as yet in an incomplete condition. True it is that the fruits of all our preparatory labor were only then beginning to reach the western front in quantity. But true it is, also, that had the war stretched on into 1919, our rapidly increasing armies at the front would have been supplied with every war necessity upon such a generous scale that the surplus which existed at the armistice would have been fully consumed.

It is unquestionable that the enormous extent of our preparations for 1919 went a long way toward causing the German army to get cold feet in 1918. Moreover, in all fairness, we should remember that the War Department bent its energies so ably to the solution of the sudden emergency presented by the German collapse, that it was able to realize over 4½ billion dollars by the sale of surplus supplies and the settling of claims.

No. The outstanding lesson of this whole matter is that those among us, who, like General Wood, worked day in and day out to urge upon Congress the necessity for preparedness, have received in this matter a tremendous endorsement of their policy. The War Department made mistakes, of course. Who does not? But had their program of 1917 been absolutely flawless, the 25 billions of dollars' indebtedness that is upon us today would have been but slightly reduced. Had we on the other hand but listened to the voice of Wood in 1914 and 1915, the Germans would have asked for an armistice at least one and possibly two years sooner than they did, and it is certain that our present war expenses and those of our allies would have been cut in half.

A Stupendous Rapid-Transit Problem

UNQUESTIONABLY, the most pressing engineering problem of the day in New York City is to provide adequate rapid transit facilities, not alone for the present population but for the teeming millions which are being added to the city at a rate which steadily accelerates year by year.

The ideal topography for meeting such conditions would be that in which the various lines of travel were able to radiate in all directions freely and without any physical obstacles to prevent the construction of subways, elevated roads and street car lines. Instances of these conditions are to be found in London, Paris and Berlin, where the rivers upon which the cities are situated are so narrow as to afford but slight obstacles to the construction of bridges and tunnels. The business center of New York, however, is situated on the lower half of Manhattan Island, which, with an average width of less than two miles, extends north and south for a distance of ten miles and is hemmed in by the deep and broad East and North Rivers, the former necessitating bridges with a clear span of 1,500 to 1,600 feet and the latter calling for a clear span of the unprecedented length of 3,000 feet and over.

Modern developments in civil and electrical engineering have made possible the crossing of these natural obstacles by the alternative method of tunneling. The Greathead shield and electric traction have brought the cost of tunnel construction and operation within practicable limits, although the crossing by bridge still remains, and always will, a far more economical method when compared on the basis of cost per single track; and it has, of course, the advantage of being a more pleasant mode of travel from the viewpoint of the passenger.

The configuration of Manhattan, which is today and always will be the commercial hub of our great city, greatly complicates the problem of providing rapid transit service, for the reason that the natural flow of traffic is north and south through the avenues, and in the early years of the history of transportation, we find that the bulk of the travel moved in these directions. Even in the future, when the North and East Rivers shall have been crossed by a multiplicity of bridges and tunnels, the city will be at a disadvantage as compared with those having a radial system of distribution, because of the fact that rapid transit to the south and southwest is hindered by the broad waters of New York Bay. In a city like Paris, having a free radial distribution, the territory served increases as the square of the distance from the city center, whereas in Manhattan it increases directly as the distance.

We invite the citizens of New York to make a careful study of the present and future problem of transportation in their city as portrayed in the map and diagrams on the front page of this issue and as described in the article on page 500. The engineers and the Transit Construction Commission are to be congratulated upon their foresight in making such a comprehensive study of this problem and presenting it for public consideration. Easy it is to be wise after the event; but, as the history of municipal improvements has shown, it is very difficult to teach the public wisdom before the event—the wisdom of judicious foresight and preparation. No one can study the statistics which are here presented without realizing that unless the city fathers hasten the completion of the present subways, and act upon the proposed plans to take care of the increase in travel for the next twenty-five years, we shall sooner or later, and rather sooner than later, find ourselves confronted with a congestion of travel which would be little short of a public calamity.

In justification of the above warning, and having in mind the frightful jam which occurs in the rush hours even today, we invite attention to the fact that from 1910 to 1920 rapid transit travel on all lines increased, roughly, from 1½ billion passengers per year to about 2½ billion, and that within the next twenty-five years these figures will have doubled to 5 billion passengers, and fifty years later or by the end of the century, there will be an annual travel of some 9 billion passengers.

The Naval Experimental Laboratory

THE new naval laboratory for which Congress has appropriated $2,000,000, owes its inception to the Naval Consulting Board. It will be remembered that one of the first recommendations of this body was the building of a large and thoroughly equipped laboratory in which promising inventions could be investigated and rejected or developed, as the case might be, on a scale and with a completeness which existing conditions in the Navy Department rendered impossible. In furtherance of this scheme a committee of the Board, composed of men who were expert in laboratory work, was appointed to formulate a general plane and select a site. For various reasons, they reported to the Board in favor of Annapolis; but in the discussion which followed some diversity of opinion developed, notably in the case of Mr. Edison, who was strongly in favor of New York.

This took place after 1914 and before our entrance into the European war. The rush of our preparation for that great conflict and the multiplicity of larger problems that developed, coupled with the fact that there was an offer to the Government of many private and well-appointed laboratories, caused the subject to be dropped for the time being. It should be mentioned, however, that the choice of Annapolis was favored by naval officers, who pointed out that the Government had already established an experimental laboratory at that location, which had cost about $600,000, and that there was ample land for expansion of the plant. Also it was urged very strongly that the work of the laboratory be coördinated with that of the Naval Academy, and particularly with the work of the postgraduate school, which, by the way, has been opened up again since the war, and is to be greatly expanded. The point was made that an adequate experimental and research laboratory at the naval college would enable the student officers to do special research work, and that the experts of the laboratory might be employed as lecturers at the postgraduate school. In the minds of many naval officers this was the strongest of all considerations.

However, the laboratory committee, after giving due wieght to the opinion of naval officers, has finally decided against Annapolis, and in favor of a site at Bellevue, a naval reservation near Glesboro Point on the Potomac and lying in the District of Columbia. The site is opposite and about one mile distant from the War College at Washington.

The principal considerations which led to the choice of the Washington site are first, the desirability of locating the laboratory as near as possible to the Bureau of Standards, with which institution the work of the laboratory must necessarily be carried on in close and continual coöperation. Secondly, it was considered desirable that the laboratory should be built within easy reach of the various naval bureaus, particularly those of Construction and Repair, Steam Engineering and Ordnance. Another consideration was that of assuring the future finances of the institution, which would have to come in the form of appropriations from Congress. Laboratory work and plant is frequently difficult to explain to the lay mind. If the laboratory were located within half an hour's automobile ride from the Capitol, it would be possible to take the committee down and show them work which was being done and explain on the spot why the requisite appropriations were necessary. A final reason and alas, perhaps the most important of all, was that by locating the laboratory in the District of Columbia, whose residents have no vote, it would insure that the financial prosperity of the institution would not depend upon those familiar tactics known under the name of "log-rolling." If Congressmen had no particular political object to further by giving or withholding appropriations, it was realized that the prospects of the claims of the laboratory obtaining just and unbiased consideration would be greatly enhanced.

Engineering

Nicaragua's Highways, according to the American Consul, are the rivers and lagoons. There is not a mile of road anywhere in the Bluefields district. However, the fact that the Nicaraguan Government appropriated $250,000 out of the national revenues of the Republic for the construction of certain automobile highways seems to indicate that the beginnings of a definite plan for such construction have been made. During 1919 three automobile roads approximating 200 miles were under construction, as follows: From Porto Dias to La Libertad, from Managua to Matagalpa, and from Montagalpa to the Pacific Coast.

Cement-Lined Service Pipes.—Among other economies introduced in the waterworks department of Lynn, Mass., whereby that town was able to offset advances in prices and wages and maintain the water supply at the old figure, was the substitution of cement-lined pipe for an expensive type of lined pipe which did not stand up very satisfactorily with Lynn water. To prevent the breaking of the lining with ordinary pipe-cutters, all pipe was cut in the shop to fit the requirements by the use of a metal cutting machine, which, on a test with a single blade, cut 140 ⅛-inch disks from a piece of 1-inch lined pipe without breaking the cement. To prevent exposed threads in connections, malleable iron countersunk fittings are used, which are lined in the shop with lead, leaving only six threads unlined. When this lining comes in contact with the cement lining of the pipe it makes a snug fit without danger of crushing the latter.

The Hudson Bay Railway.—Agitation is being renewed in western Canada for the resumption of work on the Hudson Bay Railway, now needing only 92 miles of construction to complete a short cut across the narrow end of the globe, reducing the distance from Calgary to Liverpool by about 1,350 miles. The deep-water development of the harbor at Port Nelson, consisting of an artificially constructed island, situated near the outer edge of the tidal flats, about two-thirds of a mile from shore, connected with the mainland by a bridge of seventeen spans, has created some opposition to those who favored Port Churchill for the railway terminus. The island as built is now one-half mile in length and enclosed on all but the deep-water face by timber crib retaining works, and the interior has been partly filled with material dredged from the site of the deep-water wharves and channel. The work was greatly interfered with on account of the war.

The Use of Compressed Gas.—It appears as though all progressive countries are making extensive use of compressed gas for various purposes. Argentine Republic, for instance, is manufacturing and compressing gas locally and the output of the factories is used by the entire country. The machinery for its manufacture was originally imported from France and Germany. Compressed gases are used in Canada, in connection with industrial establishments and hospitals. Importation is made in large cylinders, the gas being repumped into smaller ones for distribution. The gases come from the United States. In India compressed gases are generally used by the principal engineering, shipping, dock, and railway concerns for welding and cutting metal; also in many of the hospitals. The gases are of local manufacture. In Sweden compressed gases are being used extensively for welding. Shipyards and large shops produce the gas in their own plants instead of buying cylinders with compressed gas. Machinery for the production of compressed gas was formerly obtained in Germany and France, but Sweden now supplies its own markets.

Building Blocks from Clinkers.—A local enterprise of Brest, France, which suspended operation during the war has recommended the production of building blocks that are gaining widespread usage in the Brest district in certain kinds of building construction. The blocks are made in molds as are cement building blocks in the United States. The materials used are sand, lime, and cement, with a base of crushed coal clinkers. The lower grade of blocks also contain some coal cinders. These blocks are made in several sizes. The size 10 by 20 by 6 inches sells for 237 francs per hundred blocks. The clinker building blocks are particularly used in pavements, walls, floors of cellars, warehouses, stables, garages, rough buildings and small residences. The blocks have the advantage over brick for building material in that they are cheaper and facilitate quick construction. They take plaster on the interior and stucco on the exterior where it is desirable in buildings. However, the outstanding advantage of the clinker block over the brick in the Brest district is the capacity of the former to withstand the great humidity of the climate that causes brick walls to drip water in the interior of the houses.

Science

Dust Hazard in Wet Grinding.—The Public Health Service has published a report by Messrs. Winslow and Greenburg on the dust content of the air in the grinding rooms of a large Connecticut factory, where wet grinding is the rule. This process is generally supposed to be relatively harmless to the workman. In the case examined, however, the air was found to contain, on an average, 15,800,000, and in one sample 50,000,000 particles, mostly 1 or 2 microns in diameter, per cubic foot. The dangerous condition thus indicated is confirmed by the fact that the tuberculosis death rate among the operatives is ten times that of the general population. In order to facilitate rapid work, the grinders are tempted to cut down the amount of water supplied to the wheel, and in grinding a heavy object like an ax upon a wheel of soft natural sandstone the worker presses so heavily upon the wheel that the superficial layer of water is pushed back behind the ax and the outer surface of moist stone is ground off, exposing a dry surface, which, in its turn, is abraded and discharged as atmospheric dust. In view of these conditions, it would be a benefit to the workers to substitute dry grinding, with an efficient exhaust system.

How Do Raindrops Form?—The stereotyped explanation of the formation of raindrops contains some rather striking fallacies. It is assumed that when air is cooled below the dew-point condensation occurs on the nuclei present; that the larger droplets, owing to their lesser vapor tension, grow at the expense of the smaller; and that the larger and more rapidly falling drops coalesce with others on their downward path to form full-sized raindrops. Dr. W. J. Humphreys, who dealt with this subject at the last meeting of the American Physical Society, pointed out that the number of condensation nuclei in a given volume of air is ordinarily so great that the amount of moisture present could not form drops as large as raindrops around them. In fact, the available space would not hold as many raindrops as there are nuclei. It is true that the larger drops do grow at the expense of the smaller, but according to theory, at a rate far too slow to be effective in the process of rain production. Lastly, even if a droplet should fall quite through a cloud layer and actually coalesce with all the particles in its path, the chance of its thus becoming a full-sized raindrop would be very small. Dr. Humphreys explains rain formation thus: Humid air ascends and forms cloud droplets on the nuclei present as soon as the air cools below the dew-point. The drops in the lower part of the cloud thus formed filter out most of the nuclei from the air ascending still higher. Thus at upper levels there are so few nuclei that a drop of "falling" size can form around each of them. These drops doubtless often grow larger through coalescence with other drops during their fall. The last process is facilitated by the electric charge which the drops usually have.

The Uses of Helium.—The production of helium on an extensive scale which began during the war, when it was proposed to use this gas for filling balloons and dirigibles, has led to considerable discussion as to other ways in which helium can be used. Prof. J. C. McLennan deals at length with this question in a lecture, published in *Nature*. It appears, in the first place, that if helium is used for filling airships the supply from the British Empire would be far from adequate for the British air fleet. One way of economizing it, would be to use it only in compartments adjacent to the engines. As to various industrial uses, it may be used as a filling for thermionic amplifying valves of the ionization type; also for filling tungsten incandescent lamps, especially for signal purposes where rapid dimming is essential, and for producing gas arc lamps in which tungsten terminals are used. Some objections to these uses are pointed out. Nutting has shown that Geissler tubes filled with helium are very suitable, under certain conditions, for light standards in spectrophotometry. Helium is also invaluable in spectroscopy, and for various other laboratory uses. Elihu Thomson has suggested that if divers were supplied with a mixture of oxygen and helium, the rate of expulsion of carbon dioxide from the lungs might be increased, and thus the period of submergence might be considerably lengthened. The widest application of helium, however, appears to be in the field of low temperature research, as liquid helium—and perhaps eventually solid helium—enables one to reach the lowest temperatures attainable by any means. A point of special importance to which Professor McLennan calls attention is that the supplies of natural gas from which helium can be extracted are being rapidly used up; hence it might be well to store a supply of this gas for use in years to come.

Industrial Efficiency

Shoes from Mud Shark Skins.—Fancy footwear and other novelties are to be manufactured by a company of Victoria, B. C., from the skins of mud sharks. Operations are now under way. The company has been granted an exclusive license to fish for mud sharks in the Gulf of Georgia.

France's Steel Industry.—Steel manufacturers and merchants throughout France are all of the some opinion—that the present demand in France for foreign steel products, including plates, sheets, beams, sections, channels, wire rods, tubes, and angles for railway car construction will continue for at least a year. No home-made plate is available for the independent shipbuilding plants. Such ship plate as is now produced passes directly from the mills to shipyards in which the mills are financially interested. It is said that by this month only 25 per cent of the mills are operating, due to the shortage of materials.

Paper Pulp from Congo.—Papyrus, which grows in great abundance near Elizabethville, in the Belgian Congo, principally along the lower Lualaba, near the lakes of Kabull, Sjemba, Kisali, and Neaga, is to be exploited by a large company which has been granted a concession. It is planned to establish near the river a large plant, costing two and a half million francs, which will have an initial production of 20,000 tons of pulp. The material for this factory is to be sought among the Belgian, and, if necessary, allied manufacturers. The papyrus of the Congo has shown on analysis to contain 37.8 per cent cellulose. After research and experiments, a process was discovered for bleaching the plant.

The Pigment Deposits.—The discovery of an extensive deposit of ocher and sienna at no great distance from the surface and within 30 miles of Adelaide, South Australia, has attracted much local interest, particularly in view of the abnormally high price of imported paint pigments. Though regarded primarily as a mining proposition, the discovery is important in a manufacturing sense. During the years of war several new paint works were established in Australia, but the promoters were handicapped to some extent by the necessity of importing most of the requisite raw materials. This new find of ocher and sienna therefore extends the possibilities of the paint industry and should render it largely independent of overseas supplies of the basic pigments.

Peat as Locomotive Fuel.—Interesting trials to test the possibilities of peat as fuel for locomotives have been in progress for some months on several railroads in Sweden. The reports so far show favorable results. One privately owned railroad in southern Sweden, 256 miles in length, has found peat so practical for steam purposes that the management believes the road can dispense entirely with coal. The State railways have likewise been testing peat for steam purposes, with good results, and have on a limited scale adopted it for fuel. For some years the State railways have been operating a factory for the production of peat powder, which is said to be an excellent fuel. In Sweden, where there are 10,000,000 acres of peat bogs, with an average depth of 6.6 feet, the substitution of peat for coal would add enormously to the national wealth. Every acre of peat bog yields nearly 1,000 tons of prepared peat.

America's Option on German Chemical Drugs.—The Reparation Commission has offered to the United States Government the right to participate in the purchase of certain chemical drugs from stocks impounded in Germany as well as from the subsequent production of German manufacturers, rendered available to the Commission by the Treaty of Versailles. From the records in possession of the War Trade Board Section it would appear that practically all these chemical drugs are now being manufactured in the United States and are available to the American consumer on reasonable terms as to price, quality, and production. Reliable reports indicate that the domestic product is equal to the German in quality; that the average price is substantially the same as that asked by the German manufacturers for stocks of current production; and that these drugs are manufactured in this country in quantity sufficient to meet all indicated domestic demand. The foregoing covers not only synthetic organics of commerce, but likewise practically all of the German patented products. For this reason this Government does not feel it advisable to take active steps to place upon the market foreign-made drugs which would compete with those of domestic manufacture, and, therefore, will not exercise its option upon impounded stocks of chemical drugs of German manufacture or upon stocks of chemical drugs manufactured during the months January, 1920, to June, 1920, inclusive.

The State and the Farmer

Successful Development of the California Land Settlement Scheme

By H. A. Crafts

THE California State Land Settlement Scheme at Durham, Butte County, was launched in 1918, and is the first settlement of the kind to be established in the United States.

A tract of 6,219 acres of farm land purchased by the State was subdivided into small farms, ranging in size from two to one hundred and fifty acres.

Levelling and checking land for California's experiment in directed semi-cooperative farming

The spirit in which the colony was started is best indicated by the enabling act adopted by the California State Legislature in 1917, which contains the following clause:

"The Legislature believes that land settlement is a problem of great importance to the welfare of all the people of the State of California, and for that reason through this particular act endeavors to improve the general economic and social conditions of agricultural settlers within the State, and of the people of the State in general."

By provisions of this act the Legislature appropriated the sum of $260,000, of which $250,000 was constituted a revolving fund for the purpose of purchasing and improving farm lands to be sold in turn to bona fide settlers.

The land purchased for this first settlement was a part of the old Senator Leland Stanford estate and with the exception of about one thousand acres is composed of deep, rich alluvial land, lying along the shores of Butte Creek.

Under two allotments and sale in 1918 the entire tract was quickly disposed of, and provided beautiful and productive homes for 120 families, including 200 children.

The enterprise is not of an eleemosynary character, but one designed to help real farmers, possessing real capital, to accomplish better results in the way of practical agriculture. The State Land Settlement Board, a body consisting of five members appointed by the Governor of the State, exercised great pains in allotting the settlement-farms to desirable purchasers. Due consideration was taken of moral character, practical farm experience and financial standing, with a view of welding the settlement into a permanent and prosperous community.

The cost of the land to the Board was $100 per acre for that portion which was susceptible of irrigation, and $10 per acre for that portion that was non-irrigable. Of the latter there were only about 700 acres. This land in turn was sold to settlers at an average price of $150 per acre, and the total price of farm units ranged from $3,600 to $15,000.

The terms of sale to settlers included a cash payment of five per cent of the purchase price, with deferred payments extending over a period of forty years, at five per cent interest. Loans were extended for farm houses and other permanent improvements up to sixty per cent of their cost with twenty years for repayment. No loan for this purpose was made above $3,000.

Very wisely the State Land Settlement Board took cognizance of the vexed question of farm labor and provided for the allotment of two-acre tracts for this class of settlers. These lots were eagerly taken. The initial payment on each lot was less than $20, and deferred payments were arranged on the same basis as those made to farm settlers.

This arrangement was made with a double purpose—that of providing the settlement with a permanent supply of farm help and also of raising the standard of general farm help to a higher level.

The farm laborers of the settlement were enabled to earn from $2.50 to $3.50 per day, with board, or $4.50 without board. Carpenters were paid $5.25 per day of eight hours and were enabled to improve their allotments outside of the working hours.

These settlement farm laborers have the option of either working inside or outside of the colony. They are permitted, as soon as they are financially competent, to purchase larger farms, and thus become proprietary or employing farmers.

The offices of the California State Land Settlement Board do not cease with the mere buying and selling of this land, leaving the settlers to shift for themselves. The most important work comes after the settlers have selected farms and have begun the arduous task of producing a revenue that will enable them to pay for and equip their new homes.

The Board does all in its power to guide the collective work of the settlement along safe lines, supplying farm advisers, farmstead engineers and other experts to help the good work along. It is the plan of the Board to assist the settlement in welding itself into a successful coöperative community, and to inaugurate a system of the most scientific and up-to-date cultural and administrative methods.

At the very outset the Durham settlers organized a Coöperative Stock Breeders' Association. This was done with the prime object of making the settlement the home of pure-bred live stock. The Board inculcated the idea of uniform selection of breeds so that there should be no untoward mixing of blood.

It was agreed that there should be but one or two breeds of cattle, sheep and hogs in the association. For cattle the Holstein was adopted as the type for dairy stock, and short horns for beef purposes. Duroc Jerseys were selected as the desirable type of hogs, and the Romney Marsh and Rambouillet for the sheep breeds. The executive committee of the Settlement Coöperative Live Stock Association has done nearly all the buying of live stock for the settlers thus simplifying and expediting matters.

Instead of leaving each of the 120 families, composing the settlement, to buy material, find workmen and secure designs for their dwellings and farm buildings the Board took it upon itself to lend a most welcome helping hand. It aided the settlers in their purchase of fencing material, cement, lumber, pipe, etc., in carload lots, thus saving the new farmers much labor trouble and insuring them the best of material at lowest prices.

The plans for the new farm houses and their proper location on the respective farms were worked out with much care by the farmstead engineer under the eye of the farmer and his wife and in coöperation with them. In fact all the important

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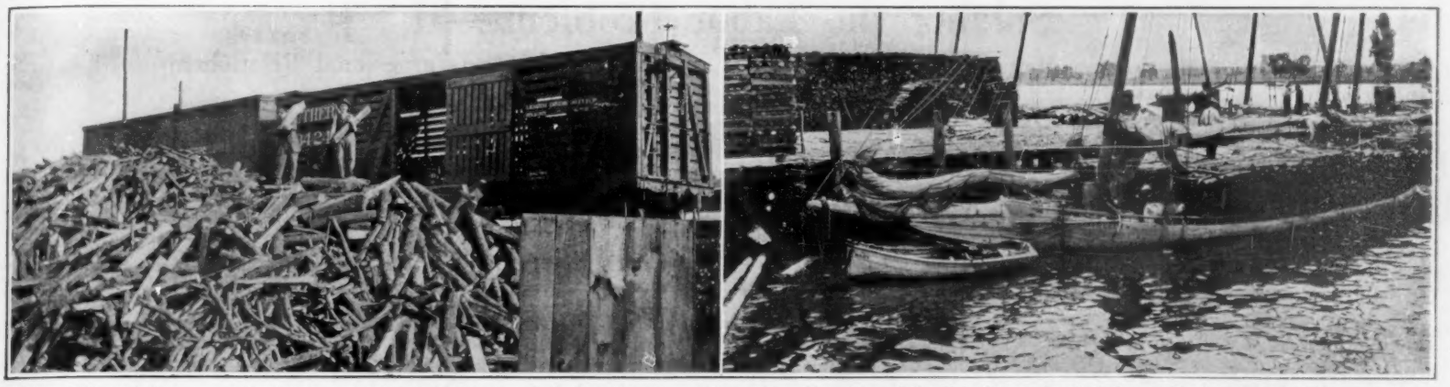
THE United States, as is clearly shown by so much of the 1920 census returns as has been made public, still suffers from the tendency of the rural population to gravitate toward the city. Ways and means of meeting this situation and insuring that we shall have left enough producers of food to feed the nation are becoming more essential every year. One way is to make it easier for the small farmer to acquire title to the land which he works, and to aid him in the successful cultivation of that land. This sounds like the cooperative schemes which have failed with such singular unanimity wherever they have been tried; that it does not necessarily involve the weak elements leading toward such failures must be concluded from the great success which has attended the California Land Settlement scheme. What this is and how it has worked Mr. Crafts tells us in this story.—THE EDITOR.

A typical farm-house erected under State aid in the Durham settlement

Digging trenches for concrete irrigation pipe lines at Durham



Right: Sailboats bringing wood for fuel down the river to Washington, D. C., in anticipation of the coming cold weather. *Left:* Unloading cordwood at the municipal wood yard at Knoxville, Tenn. About 135 cords are shown in this pile.

The farm woodlots kept many home fires burning during the fuel shortage of 1918. Will history repeat itself this winter?

Winter Fuel from Our Woodlands

By Arthur L. Dahl

WHETHER or not there will be a shortage of fuel in our cities and towns this winter will depend upon economic conditions, for congested railroad traffic or another strike in the coal regions will soon result in making many people shiver at the icy blasts of winter, for storage stocks are inadequate almost everywhere. Coal is almost the universal fuel for heating in the home, for oil is only used in the larger apartments, hotels and public buildings providing steam heat. When coal is obtainable, it is undoubtedly the most satisfactory, but when the supply is short our thoughts turn to the fuel of Lincoln's day, and we would give a lot for some of the split rails that helped him earn a meager living.

The farm woodlots during the fuel shortage of 1918 enabled many of the home fires to be kept burning, for thousands of cords were then cut and hauled into nearby towns to take the place of coal, not only for heating the home but often to keep the wheels of industry moving.

Two pounds of seasoned wood have a fuel value equal to one pound of coal, and while different kinds of wood have different fuel values, generally, the greater the dry weight of a non-resinous wood the more heat it will give out when burned. A cord of hickory, oak, beech, birch, maple, locust or cherry, weighing about 4,000 pounds, is equal to one ton of coal. Other species, having less heat value, such as hemlock, red gum, sycamore or shortleaf pine, require a cord and a half to equal a ton of coal. Two cords of such woods as cedar, redwood, poplar, cypress, spruce and white pine are needed to equal the heat value of a ton of coal. Resinous woods have a greater heat value per pound than non-resinous woods, and this increased value varies with the resin content. The available heat value of wood likewise depends upon the amount of moisture present. With green wood much of the heat it is capable of giving is used up in evaporating the water.

Woods have different characteristics in burning, some furnishing a quick, intense heat, while others will burn slowly and evenly. Hickory, of the non-resinous woods, has the highest fuel value per unit volume of wood, and it burns evenly, and holds the heat. Oaks, beech, birch, and maple have somewhat the same qualities, in varying degrees, while the white pines have a relatively low heat value per unit volume, but they ignite readily and give out a quick hot flame, but do not last long. Woods containing lots of resin, although giving an intense heat, give out a large volume of oily black smoke that is often objectionable around the home.

Under normal conditions the United States use about one hundred million cords of wood annually for fuel, of which about 80 per cent is consumed in the rural districts. In spite of the fact that most of our farm woodlands occur in the 17 States making up New England and the Lake States, the farmers and rural population of this section annually use in excess of 18,000,000 tons of coal. If by substituting wood one-quarter less coal could be burned on farms and one-tenth less in villages, the total saving would amount to nearly 3,000,000 tons, or between 65,000 and 70,000 carloads.

Wood, being a bulky and heavy commodity, does not justify shipment for very long distances by rail, but where water transportation is available, considerable cord wood finds its way to the urban markets, for loaded on flats or rafts, a large quantity can be transported at slight expense. Accordingly, along most of our waterways cordwood is one of the articles of commerce, especially when a coal shortage creates an unusual demand for fuel wood.

The development of power farming has resulted in increasing the amount of marketable products from farm woodlots, for in the early days it was necessary to cut up the tree trunks with a hand axe, a slow and arduous undertaking, and few farmers thought the returns were adequate. With the modern tractor, however, to furnish belt power for a small portable saw outfit, it is possible to cut up in a few days a considerable quantity of timber, and farmers owning tractors are more and more getting into the habit of cutting up the dead and down timber and of thinning out their woodlands.

The matter of supplying cordwood from our farms is entirely an economic one. While there are some 143,392,000 acres of woodland on the farms in the

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Forewarnings About Forest Fires

By G. H. Dacy

UNCLE SAM, woodsman de luxe, has over 154,000,000 acres of national forest to maintain, improve and guide and guard against fire losses. Destructive conflagrations are the most insidious and insistent foes which the Government has to combat in its efforts to conserve and improve our timber resources. The Federal Forest Service utilizes a unique mechanical display in illustrating pictorially how forest fires emanate. It is not a cinema, although it appears like a motion picture to the spectator. A metal disk five feet in diameter which is driven by a motor is divided into five units separated by vertical partitions, each section consisting of a model of a heavily forested hillside. Each of the five units presents a different cause of forest fire.

Lightning is a fertile source of timberland conflagrations. How lightning causes fire is shown by means of an invisible electric wire which is suspended above the highest trees of one of the models. As the large disk spins around and this particular unit appears before the spectator, an electric spark is made to jump from the invisible wire apparently located in a big, black cloud to one of the trees whence, apparently, the blaze soon spreads over the forest. This effect is accomplished by means of a red electric lamp underneath the hillside, which is practically transparent.

Ranchers and settlers who are extending their areas of cleared land often start bonfires to destroy the debris. Occasionally on a windy day, the fires get beyond control or on the sly shoot out sparks which ignite neighboring woodland. Stupendous losses of valuable timber annually result from such causes. Another segment of the revolving disk pictures such an occurrence, the clearing, dwellings and live stock of the settler being plainly shown in the foreground of the model. Neglected and abandoned camp fires left by careless hunters, fishermen or campers are also prolific in the annual tribute they exact in the way of despoiled woodland. A third reproduction deals with this subject, the camper's tent being shown in the valley with a smouldering fire nearby which gradually blazes and spreads to the neighboring underbrush.

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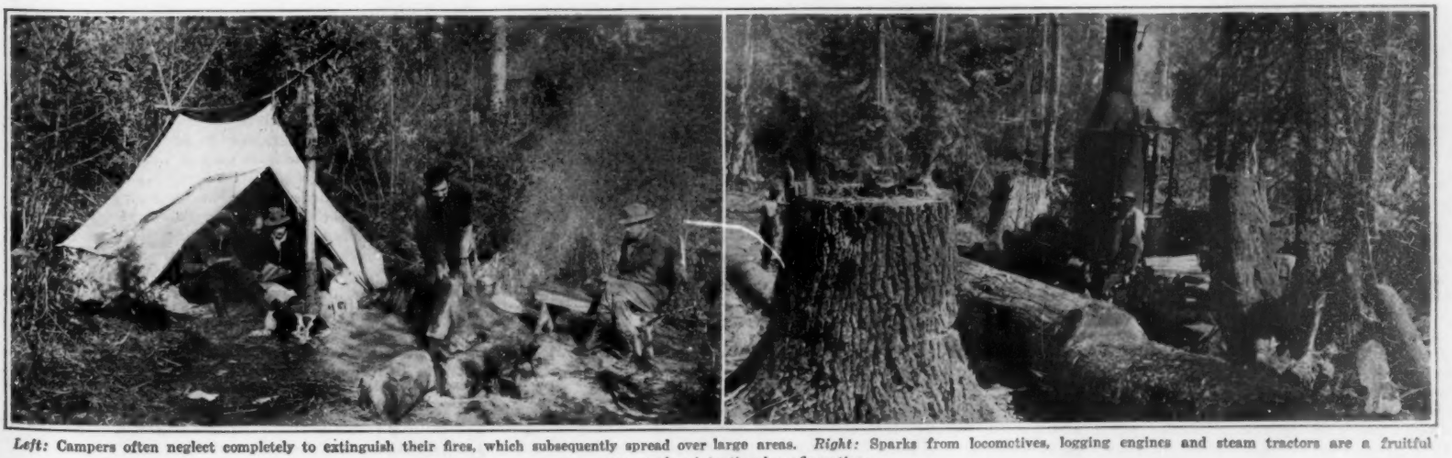

Left: Campers often neglect completely to extinguish their fires, which subsequently spread over large areas. *Right:* Sparks from locomotives, logging engines and steam tractors are a fruitful source of unintentional conflagrations.

Where the forest fires come from and why due care should be exercised at all times

Solving the Labor Problem—II

Man-to-man Contact Between Capital and Labor in Place of the Old Impersonal Relationship

By H. C. Osborn, President, American Multigraph Company

IT seems to me that in our more or less popular discussions of Capital and Labor, we have been satisfied to concern ourselves with details at the sacrifice of fundamentals.

The turmoil between Capital and Labor is not so much ignorance as it is misinformation—and I find one side as misinformed as the other. The trouble seems to be the gradual elimination of the man-to-man contact of a generation ago, replacing it with cold, impersonal employment relationships.

By way of contrast, I recall the stories told me by men who worked for my grandfather. He was the founder of one of Cleveland's big rolling mills and one of the first employers of large groups of men. They tell me that he and his men were real friends; that at noon time he and the men would take their lunch boxes out into the mill yard and seated upon a pile of rails, discuss everything from politics to business. He never knew what labor trouble was. He knew his men, they knew him, and both groups knew all about the business that gave them their living.

Then, when I was finishing my education I became an apprentice machinist in a big Cleveland shop. There I got the other viewpoint. The angle of the man who does not understand the business but who feels himself oppressed by a "System" of which an invisible "Big Boss" is the directing force. To me and the men I worked with, the one aim in life was to get as much as possible for the services rendered. We never knew what the business was all about—and no one in the business seemed to care much whether we found out. There was sort of an atmosphere of "Choosing Sides." We working men had our side and "They" had theirs.

It's that sort of thing that has increased and multiplied to the point that we have now reached. Business has allowed its two factors to become so interested in watching one another that there seem to be few people left to interest themselves in business.

Before we talk about improving conditions, we must recognize the fundamental conditions that are at work and set about bringing a real recognition, on the part of both capital and labor, of the fact that alone they count for nothing—combined, they are useful to themselves only so long as they serve the purpose for which the business was created—rendering some sort of a service to a customer.

From our earliest days we have tried to keep that ideal before ourselves and our men. The first multigraphs built were delivered to Cleveland concerns, and so great was the interest of the men building them that many of the fellows (there were about fifteen of them) had private records of where those multigraphs were and how they were functioning.

We have tried to preserve this spirit as we grew. We have tried to show each man that the part he was working on had some definite service to perform for a customer. By means of talks, charts and pamphlets we have endeavored to show our men the correct relationship between capital and labor, and the part they, as individuals, played in the world of business.

One of these talks, "Modern Business Organization," traced the history of business from the barter age to the present-day corporation. It took the men through the various stages of business and traced the relationship of capital to labor, pointing out their absolute dependence upon each other and their united dependence upon a customer. The result of this was a more united understanding of the part that the worker plays in industry, plus a keener interest in the daily task, because of the realization of the importance of the customer.

Another talk, "Cash to Cash," dealt with the company balance sheet. In this talk we took our annual statement and analyzed it, pointing out the various factors that make up our business and their correct relationship to each other. Overhead, dividends, taxes, surplus, and reserve—all those otherwise unintelligible terms were explained and illustrated by charts and demonstration. Overhead, for instance, was demonstrated to the men by having those whose jobs were part of non-productive labor explain what they did and why it was important. We began with the salesman; had him turn his order over to the clerk in his office, who in turn presented it to the order department man, who then passed his orders around to the various production control units, and so on until the manufacturing order was out in the factory and the man at the machine was at work. By this means we demonstrated the need and importance of the so-called "White Collar" man, and the factory man saw Overhead as an assistant rather than a burden.

All this took time. The course took about a year to give, and covered all possible phases of our business and industrial relations. It was given to a group of about two hundred men who stayed after hours to take the course. We called it our "General Shop Efficiency" course, and out of it grew a demand for the present educational work which covers Foremanship, Mathematics, Shop Practice, Blue Print Reading, Corrective English and Public Speaking, Advertising and Salesmanship, and Business Arithmetic.

THE very magnitude of modern industry has introduced numerous problems which were unknown to the business minds of a generation ago. Problems of securing raw materials, transportation, distribution, publicity, labor—all of these are peculiar to our present industry. But of all these problems none appears to be so persistent and so difficult to solve as that of labor. How to obtain the proper kind of labor, make it take an interest in the work and ideals of the organization, and prevent it from drifting from place to place with all the losses which such practice entails, is the problem before us. In a previous article we had Mr. Verity, President of the American Rolling Mill Company, explain his company's plan for solving the labor question. This time Mr. Osborn, President of the American Multigraph Company, gives his views and experience on this great question.—THE EDITOR.

H. C. Osborn, who calls our attention to the fundamental conditions of the labor problem and how they may be met

Immediately following our course in "Workingmen's Economics" we began discussing employe representation. Here again charts were used. We showed how the Board of Directors tied the stockholders and the management together, at the same time pointing out how some system of employee representation could be made to give that same contact between management and workers. We let it go at that and appointed several informal committees to investigate existing forms of employee representation and report.

The outcome of it all was the adoption, March 1st, 1919, of the system of employe representation under which we are now working. The system is our own product, made to fit our own particular requirements, but in its fundamentals resembling many of the systems now in successful operation.

We have a Congress of 24 members, elected by the workers. There is a Senate of 14 members holding office by virtue of position, each member being head of some division of our business. There is a Cabinet, the executives of the company, and in case of a total disagreement (something which in a year and a half's experience has not occurred) there is an Arbitration Board.

The Congress is further split into committees. There are fifteen of them as follows: Employment and Discharge; Education and Publication; Health, Sanitation and Safety; Suggestions; Elections; Time and Motion Study; Spoiled Work; Machinery and Tools; Production; Recreation and Entertainment; Attendance and Tardiness; Wages and Rates; Miscellaneous Complaints; Pride and Interest; Eight Hours. These committees are constantly at work on the various subjects within their control. The important point of it all is the fact that through the year and a half's experience there has never been a disagreement between the committees and the management. In many cases the management has been willing to go farther than the committee has suggested.

The outstanding accomplishments have centered around about six of the committees. The Wage and Rates Committee installed a system of classifying men according to their ability and accomplishments, then setting rates to apply to each class. Men are measured according to the specifications laid down for each class, and paid accordingly. Every six months this committee checks our rates with prevailing rates in Cleveland and makes whatever recommendations are necessary. It usually surprises our visitors when we tell them that this committee has, in many cases, refused increases, recommended decreases, and suggested the dismissal of men who were not showing progress.

The Spoiled Work Committee concerns itself chiefly with tracing causes of scrap. They fix the responsibility and suggest measures to prevent recurrence. The work of this committee has had a very decided influence in minimizing our scrap bill.

The Time and Motion Study Committee checks and approves all piece work rates. The result has been beneficial in getting rates set and accepted. Our men know that once a rate has been set it will not be changed so long as the method remains the same, and then only after this committee has rechecked the figures.

The work of the Education and Publication Committee has already been described. All educational activities are under control of this group.

The Eight Hour Committee has succeeded in having our working hours reduced from ten to nine, and, six months later to eight—without reducing production. In fact, now that raw materials are coming in better, production is coming along at a better rate than we have ever had at any time in our history. The work of this committee led them into studies of production and machine methods, resulting in many valuable suggestions; but, of even greater importance, it gave the men first-hand information on the problem of keeping the sales force supplied.

The Pride and Interest Committee is working to give our new men the Multigraph spirit—the living spirit of the craftsman who is doing a job he's proud of. Through the work of this committee new men are given some of the tradition of our business. Twice each week at lunch time in the restaurant we have demonstrations of the various models we make. These demonstrations are arranged and managed by the Pride and Interest Committee and new men are given invitations to attend. There is always a good attendance.

Throughout it all we play up the individual. We appeal to the man to make something of himself. We show him that the Multigraph offers him as broad an opportunity as he can want—and more than that,

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"Obstipui, Comae Steterint"

The Physical Sensations Accompanying the Emotions of Fear and Horror

By M. Tevis

I WAS amazed; my hair stood on end; my voice stuck in my throat"; such is the stereotyped expression of which the first two clauses stand above, and with which Virgil in numerous passages describes the emotions of the pious Æneas when confronted with some appalling spectacle. We recollect, from our own high school days, the gusto with which this familiar line was translated by the member of the class who might be so fortunate as to find it in his assignment; but we do not recall that it ever occurred to any member of the class to inquire why the emotions of terror had this particular anatomical effect upon Æneas or why they continue to produce the same symptoms in mortals of the present day and generation.

The sensations of fear and horror while entirely mental are indeed accompanied by certain marked and very curious instinctive physical reflexes, which Virgil describes with no exaggeration. Thus anyone suddenly confronted by some hideous or appalling spectacle, such as murder, death through accident, the swift and terrible destruction accomplished by a cyclone, etc., exhibits a blanched skin, a falling jaw, widely distended eyes, and similar changes of aspect. Furthermore, he is apt to feel his heart "stop," *i.e.*, check its pulsation for a moment and then begin beating violently. At the same time a cold sweat may burst from the pores of his skin, he may be seized with a violent tremor and he may feel that curious prickling sensation of the scalp commonly described in the term "my hair stood on end." All these familiar signs of a physical disturbance corresponding to a mental disturbance and occasioned by the latter operate in accordance with certain physiological laws and according to a definite mechanism.

Take the rising of the hair, for instance. The skin is covered everywhere except in the palms of the hands and the soles of the feet with hairs. These hairs are inserted in the skin obliquely, the better to fulfil their function as non-conductors of heat, as a protection from blows (upon the skull), conductors of moisture, etc. However, the hairs are not compelled constantly to retain this prone position since each hair is connected with a minute muscle so attached to its shaft as to exert a pull upon it like that of a rope upon a ship's mast. In those animals which are thickly covered with hair or with feathers this capacity for "bristling" is of great importance, since such a disposition of fur or feathers, which is commonly assumed during sleep, makes the covering of the skin warmer, for the reason that particles of hair—a notably bad conductor of heat, become entangled amid the fur or plumage and thus afford the protection against freezing or chilling which is a greater danger at night, because of the lower temperature and the lessened amount of heat generated by the fact of non-activity element.

But as we have said the hair tends to stand erect not merely through the effect of cold but in response to some mental disturbance. Thus a startled cat at once begins to bristle, which has the practical advantage of making the animal appear more alarming and dangerous to its enemies—a bluff which is often effective. Furthermore, the erected hairs present serried ranks of stiff points which are likely to make it more difficult for the enemy to seize the animal; for instance, an attacking dog would find that these stiff points were not only unpleasant to his sensitive muzzle but also that they compelled him to close his eyes, thus interfering with his onslaught. A magnified section of human skin reveals the reason for the instantaneous physical response to the mental emotion in the fact that the muscles controlling the hairs are connected with the brain centers by specially delicate and numerous nerve branches. This mechanism for the erection of the hair is particularly developed among the apes, which are the supposed relatives of man's forerunners. Writing in *Kosmos* (Stuttgart) for January, 1920, Dr. Fritz Kahn observes that this erection of the hair in animals whether induced by cold, by fright, or by anger is really a somewhat complex affair. Between the muscle whose contraction pulls the obliquely-lying hair to a more erect position, and the shaft of the hair itself, lies the gland of the hair follicle whose office it is to secrete the oil required for maintaining the smoothness and flexibility of the hair. When the fibers of the hair muscle contract this oil-filled gland is pressed tightly against the shaft of the hair so as to force out some of the oil. A very slight contraction of the hair muscle, one hardly sufficient to cause a perceptible motion of the hair itself, is enough to cause a flow of oil. Even such a slight stimulus as washing with cold water, friction with a brush or cloth, etc., is all that is necessary to cause this flow of oil. In the case of a very strong stimulus such as severe cold, violent anger, fright, nausea or disgust, the hair muscle contracts convulsively, bringing the hair to a vertical position, expressed by the term "standing on end." Furthermore, the cramped muscle presses the gland of the hair follicle so forcibly against the surface of the skin as to form little granules upon the latter about the size of millet seeds, thus occasioning the well-known phenomenon of "goose flesh." In the skin of birds these oil glands are comparatively large for the purpose of furnishing oil for the plumage, and for this reason little granules are perceptible even when the plumage is lying flat. Since the nerve impulses in response to which this condition of the skin and hair occurs, travel over the body from the brain as a center, it is natural for a person to speak of his "flesh creeping."

But when the nerves of the hair are excited by any stimulus the other organs of the skin are likewise affected. Thus the thousands of sweat glands in the subcutaneous tissue pour forth their drops of perspiration, thus producing the so-called "cold sweat." At the same time there is a contraction of the minute muscles connected with the delicate veins of the skin, forcing the blood out of all these vessels so that it runs back to the interior of the body, leaving the skin both pale and cold. Thus we have a cold sweat in contrast to the warm sweat due to heat, in which case the skin is warm and red from being filled with blood. Lastly, the combined phenomena here described produce the sensation commonly known in the words "a cold shiver ran down my back."

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Sudden Death Versus Slow Poisoning in the Hudson Vehicular Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the proposed construction of the Vehicular Hudson Tunnel for auto traffic, referred to in the SCIENTIFIC AMERICAN of Oct. 9, 1920, and also in the *Literary Digest* of Aug. 14, 1920, Prof. Yandel Henderson, consulting physiologist of the U. S. Bureau of Mines, is quoted to the effect that "If the concentration of CO in the air of the tunnel is kept down to 4:10,000, this concentration will be 'the minimum pollution for a man at rest'"; in other words, if exceptional care is taken that the CO concentration does not exceed 4:10,000, the tunnel will be safe for such traffic to those employed as auto drivers or making use of the tunnel for purposes of passenger traffic.

It has been suggested to me by Dr. Georgine Luden of the Mayo Clinic, Rochester, Minn., who has recently completed some extremely interesting investigations on the clinical after-effects of chronic carbon monoxide poisoning, that in an article on the subject by McGurn to the *Interstate Medical Journal* in 1917, that "a concentration of 1:250,000 inhaled repeatedly for several weeks and months at intervals was found to result in a serious health impairment." Dr. Luden therefore adds that "people using that tunnel, perhaps daily, are therefore going to inhale repeatedly a concentration of CO that is 100 times greater than that which resulted almost fatally in one of McGurn's cases (IV)." She adds further that "Although 4:10,000 CO may not appear to do immediate harm, it is certainly capable of doing harm in the long run and likely to produce a large crop of semi-invalids who may not at first be called neurasthenics but who will end by being ill enough to become invalids for life." McGurn's article is not referred to in Henderson's paper. He may possibly not have been aware of the case reported.

I add to the foregoing a reference to the August number of the *Journal of Pharmacology and Experimental Therapeutics*, in which Henderson and Haggard are very emphatic in their statement that "Within a few hours after profound but non-fatal poisoning with carbon monoxide no trace of the gas is found in the blood. . . . And yet for days, months and even for life structural degenerations and functional chances, usually either nervous or cardiac, may continue." The serious effects of continuous exposure to carbon monoxide have been experimentally ascertained by Dr. Luden, who is of the opinion that there is unquestionably a sensitization to the toxic effects of CO; and that therefore repeated exposure on the part of those who may use the tunnel frequently, assuming the air contamination to be to the extent indicated, will have to be reckoned with.

In a recent dissertation on the Etiological Factors of Carcinoma, submitted to the faculty of the University of Minnesota, Dr. Luden calls attention to the extreme toxicity and ubiquity of carbon monoxide in modern civilized life, the health aspects of which do not seem to have been fully recognized. She concludes that "Absence of noticeable odor, however, does not imply absence of danger. Carbon monoxide is an odorless as well as a colorless gas; its presence would never be detected by our olfactory organ were it not for the addition of the other compounds with which it is usually associated. But even the latter may fail to warn us by their odor. For McGurn was able to show that illuminating gas produced severe clinical symptoms in a dilution of 1:250,000, while Albaugh has recently emphasized the danger of concentrations of 1:2,000. It will be readily conceded that in the first named dilution the presence of the toxic gas was more than likely to escape notice. I might add that since there is a distinct advantage in visualizing the actual value of concentrations by the use of some familiar comparison, a concentration of 1:250,000 may be represented by a small glass of claret (10 cc.) diluted in 625 gallons of water, or in the second instance, mentioned by Albaugh, in five gallons of water. These figures show that the toxicity of carbon monoxide is equaled by its imperceptibility."

I bring the foregoing to your attention as an interesting contribution toward a health problem of present importance. With the technical aspects of this matter I, of course, have only a very slight acquaintance.

Newark, N. J. FREDERICK L. HOFFMAN.

Prickly Pear Not a Pear at All

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been attracted to the article on "Taking the Pricks Out of Prickly Pear" that appeared in your issue of Sept. 25, 1920, p. 305.

I don't know how accurate you desire to be in articles of such a nature, but I thought it might be wise to call your attention to several misstatements that appear in the article.

Passing the statement that this is a new use (Mr. Burbank commenced to exploit spineless cacti nearly 20 years ago), I'd like to suggest that the so-called "prickly pear" is not a pear at all, that it does not "belong to the big fruit family which (whose) name it bears," and that the part of the plant fed to cattle is not the fruit, but the thickened joints of the stems. Nor is it a "choice ration." As the author states further on in his article, it is an "emergency" feed, ordinarily used only when other more valuable feed is lacking.

The plants referred to (there are a number of species eaten by stock) belong to the cactus family in the genus *Opuntia*. Certain species of this genus have flattened, fleshy stem joints that are circular to ellipsoid in outline and from a few inches to a foot in length. These species go by the common name of "prickly pears" and this name is also applied to the globular to pear-shaped fruits, some varieties of which are to be found at the better class fruit stands in the larger cities of this country.

These plants are cultivated extensively in Mexico where the joints and fruits are used in a number of ways. They call the plant *no-pāl'* and the fruit *tu' nā.*

Washington, D. C. E. O. WOOTON.

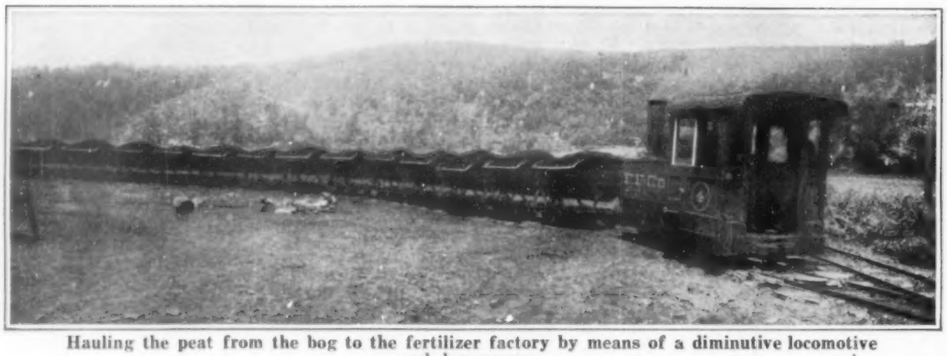
Fuel or Fertilizer?

America's Little-Known Peat Bogs and the Uses to Which They Are Being Put

By Harry A. Mount

THE word "peat" conjures to the average mind the picture of an Irish moor, with a few old men and women at the back-breaking task of spading up cubes of turf and piling them in the sun to dry for fuel. A view of one of the American peat bogs which is being worked would be a surprising sight.

One glimpses, not a great swamp waste, but an area as flat as a table and nearly as smooth. Part of it is green with a magnificent crop of celery or onions; over another part tractors drag plows and harrows, and great machines strange to the eye ply back and forth. At one corner of the bog stands a good-sized plant where the peat is turned into products of commercial value; and near it are mammoth storage piles of the black loam.



Hauling the peat from the bog to the fertilizer factory by means of a diminutive locomotive and dummy cars

Because we in America have had heretofore an abundance of virgin land and plenty of coal we have generally overlooked the value of our peat bogs. Indeed many will no doubt be surprised to hear we have any such thing in this country. Our Bureau of Mines estimates that there are in the United States about 12,000 square miles of workable peat bogs, besides a great number of beds advantageously adapted to agricultural purposes.

Aside from its value as fuel and its use in agriculture, peat has a score or more of uses, and its field is being constantly widened. A long list of chemicals are extracted from it. These include ammonia, methyl alcohol, acetone, acetic acid, pyridines, mono-phenols, a gasoline-like spirit, some neutral oils, paraffin wax, tar, and dyes.

The medicinal qualities of peat baths have made them popular in some sections of the world. During the war hundreds of tons of peat moss were used as an absorbent in dressing wounds. A process has been patented in England for making paper from the vegetable fiber found in peat bogs. By mixing molasses with properly prepared peat a food for cattle is made which is used widely in England and Germany. There are other minor uses.

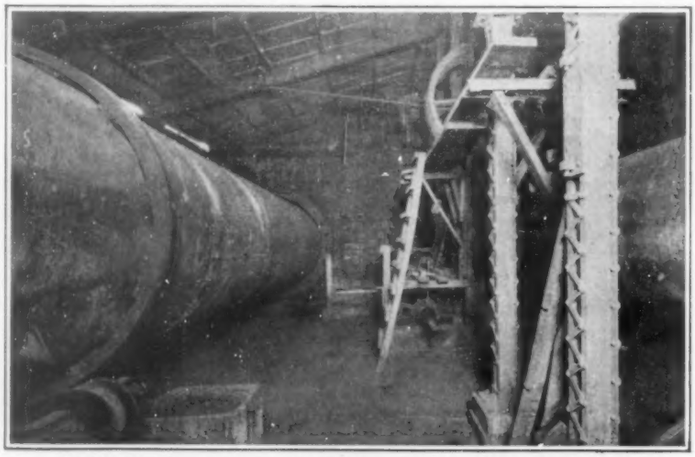
A few plants are operating in this country and Canada for the production of fuel from peat and for the by-products. As a fuel, peat has about sixty per cent the heating value of coal, ton for ton. But it can be produced very cheaply, and since European practise has already shown it can be used successfully in the industries and even in firing locomotive boilers, there is little doubt that it is a coming fuel. More will be said of this phase of the subject in another article.

By far the largest use for peat in this country thus far is in agriculture and in the production of fertilizers. The industry is a new one. In 1914 the total value of the peat consumed in this country was $367,000, of which about two-thirds was used for fertilizers. In 1918 the peat used was valued at $750,000 and although official figures are not available for 1919, the value is believed to run well over a million dollars. Of this perhaps even a larger percentage than in 1914 was used for fertilizers.

To understand the production of fertilizer from peat, it is necessary to know something of the nature of these natural deposits.

Peat deposits are built up by water plants on the beds of lakes—plants which die down annually through many years, until the deposits reach the surface and the lake is turned into a swamp. It is in this state that the peat is usually found.

The plants, as they die, are preserved by the water and a process of very slow decay takes place. If the bog is a young one, the muck which composes it will be of a fibrous nature, but if the bog is a very ancient one the fibers may have disappeared entirely and the muck will be a fine-grained loam when dried.



Putting peat on a commercial basis. The driers in the peat plant

In its natural state peat may consist largely of water; and even after the bed has been drained the peat has a moisture content of about 90 per cent. The peat retains the water just as a sponge does and before the product is of commercial value the water must be reduced either by sun drying, pressing, or with evaporating machinery.

The value of peat as a fertilizer lies principally in the fact that it is very rich in the essential plant food, nitrogen, but lime, potash and phosphoric acid added to produce a "balanced ration." But of scarcely less importance is the fact that it provides an ideal habitat for the billions of tiny bacteria which infest all soil and whose activities convert these food-chemicals into a form which the plant can assimilate. In fact, the presence of the nitrogen in the peat can be attributed to these little animals, so tiny that thousands of them can be collected on the head of a pin.

Under the microscope these bacteria are seen to be animals of the lowest form, which reproduce themselves by splitting into two parts. Under favorable conditions two bacteria grow from every one every forty minutes. Those who wish to carry out the mathematical progression will find that a single bacteria will have increased to about 165,000,000,000,000 in twenty-four hours. Of course many, many billions of them die in that time, or they would soon overrun the planet and crowd off every other form of life.

Have you ever pulled up a clover root and noticed the little balls, like tiny potatoes, clinging to it? Within these balls are millions of the particular bacteria which thrive upon the roots of clover. And each of these little balls represents the additions of so much nitrogen to the soil, for these bacteria have the power of drawing nitrogen from the air. It was known, long ago, that corn or potatoes grew better in a field which had had clover in it the year before and it has become a common practise for farmers to plant clover and plow it under as a fertilizer.

Another variety of bacterium clings in a similar way to the roots of beans, and another to peas. The plants of this family all have the peculiarity of attracting beneficial bacteria under favorable soil conditions. They are called legumes, and the little balls which gather on their roots are called nodules.

It was once the practise, when a field of clover failed to produce the nodules, to carry soil from another field of clover; and in this way the new field was inoculated with the bacteria. The farmer did not know why he did it, but with the forward march of science these bacteria were isolated, their habits studied, and they were artificially bred in gelatins. These gelatins could be purchased, mixed with water and the bacteria sprayed over the land, or mixed with the seeds which are to be grown there. But it was necessary to buy a different gelatin for each separate crop. A search for a strain of bacillus that would be universally useful proved fruitless. And then the happy discovery was made that peat is an ideal home for all varieties of these bacilli and the problem was attacked from a different angle. All of the different breeds were introduced into the peat; now this inoculant may be used for any of the

(*Continued on page 509*)

A celery crop in the New Jersey peat bogs where formerly there grew nothing but swamp grass

A Tractor That Turns in the Space It Stands On

By Ralph Howard

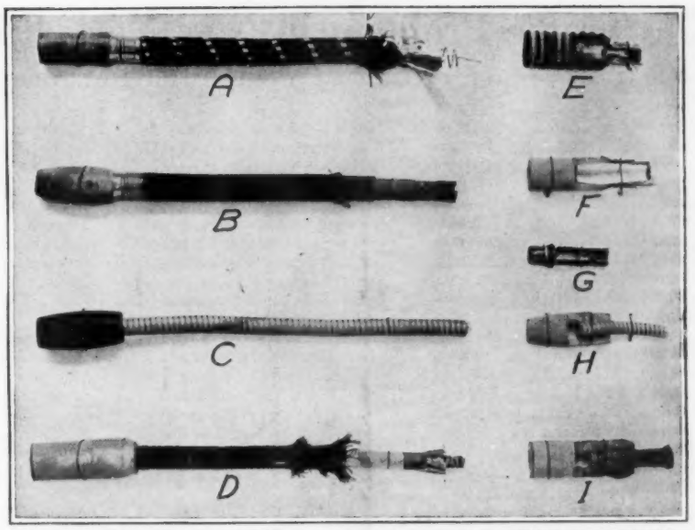
WONDERFUL as has been the progress in tractor development in the past, tractor engineers and manufacturers see a further step forward in a tractor constructed on new basic principles now being exhibited in California. Primarily, this tractor is a round-wheel type, having four wheels of equal size with the power distributed equally to all four. The wheels are arranged in pairs on the tractor and held against lateral turning movement relative to the tractor, the wheels on either side of the tractor being connected in driving relation with each other, but only one pair being connected with the power unit of the tractor. The wheels on either side of the tractor are turnably mounted on their axles independently of those on the other side and the driving connection has been arranged to be susceptible of being interrupted relative to either or both pairs of the wheels. On either side the wheels are as readily locked against rotation as they are released from their driving connection. By this means the tractor may be steered in arcs of various radii, or it may be steered at right angles to itself when short turns are made.

With the driving means so controllable as to permit the machine to be turned in arcs, the radii of which may be less than the length of the machine and from that up to any length desired by the operator, according to conditions under which the machine may be working, it became necessary to mount on the periphery of the wheels leaders of such shape and design as to permit the machine to turn without causing the leaders or guides to plow the ground. None of the wheels can be used as steering wheel independently of the tractor as a whole, but when a turning movement is to be imparted to the tractor the entire machine is turned in a rigid movement with the power so applied as not to cause any undue lateral strain on any part of the tractor. The whole operation is carried out with a pivot-like movement, produced primarily by the peculiar construction and arrangement of the leaders or guides on the wheels.

These are so constructed and mounted on the wheels that in a turning movement the leaders on the inside wheels, or non-rotating wheels, act as guides to direct the pivotal movement, but a directly opposite effect is had on the outside, or rotating wheels, to which the power is wholly or in part applied. The diameter of the circle of movement of the inside wheels may be increased or decreased by clutch control, through a relatively small movement of the steering wheel, but the general operation and function of the parts will still be present in the relation described. The entire turning movement is carried out with minimum lateral strain on the wheels or machine as a whole. A slight movement with a minimum of power is obtained by both ends of the guides being beveled so that there is a lifting effect tending to raise the wheels out of the ground instead of causing the wheels to plow the ground, as they might do were they not so beveled. The angle at which the guide may be set with respect to the axis of the wheel to obtain the maximum turning ability has been determined by practical trials. The turning movement can only be successfully accomplished when the guides are so set with respect to the axis of the wheel. The same successful turning can be done in forward or backward movement. Maximum gripping effect is necessarily of prime importance, and is secured without tearing the ground by giving depth to the leaders.

Equally important in facilitating the turning movement is the application of the power to the drive wheels. Through a specially designed transmission in which the maximum amount of power is delivered, due to the simplicity of construction, the driving power is readily applied or removed from the two wheels on either side. By the application of this power to the front wheels an equalization of power is obtained on all four wheels, which overcomes any tendency for the front end to rear up no matter how great a load the tractor may be pulling, nor how suddenly the power may be applied to the wheels. The power is evenly distributed on all of the wheels.

The operation of the tractor is simple. The operator is comfortably seated with the clutch pedal and gear shift lever at hand, and he has easy control of the movement of the tractor by a neat steering wheel. This wheel, by slight movement, operates a cam control, through which the power is applied or released from either side of the tractor. Further movement of this wheel locks the wheels on either side of the tractor. By this steering mechanism two wheels on one side of the tractor are simultaneously released and a brake applied to them with effective results.



Four types of flexible gas tubing and five end connections which were tested by the Bureau of Standards, with the results set forth in the text

Gas-Tubing Tests

By S. R. Winters

THE door is unfastened, the occupants of the room are found cold in death, the reason is unmistakable—briefly summarized, another tragedy is traceable to escaping gas. Not improbable, the leakage of the death-dealing fumes had its source in faulty gas tubings. Recognizing the hazards to life and property incident to unsatisfactory gas conveyances and connections, the Gas Engineering Section of the United States Bureau of Standards has conducted a series of experiments with relation to nine types of gas tubings, the results indicating their relative safety.

The manufacturer who wrote the Bureau of Standards, "The demand is very largely for the cheapest tubing that can be turned out that will stay tight long enough for it to be sold," probably reflects the levity with which flexible tubing and tubing ends are installed. The design which is constructed of paper, covered with glue, on a wire spiral, being covered with a cotton braiding of inviting appearance is pronounced dangerous by the Gas Engineering Section of the Government. The photograph herewith displays the nine types, the text describing each being supplied by the Bureau of Standards as follows:

(A) A dangerous type of tubing constructed of paper, covered with glue, on a wire spiral, the whole covered with a cotton braiding giving it a good outside appearance. The glue soon hardens and cracks upon bending the tubing.

(B) This tubing, constructed like a garden hose of cotton fabric impregnated with rubber, is flexible, gas-tight, but dangerous if subjected to high temperatures.

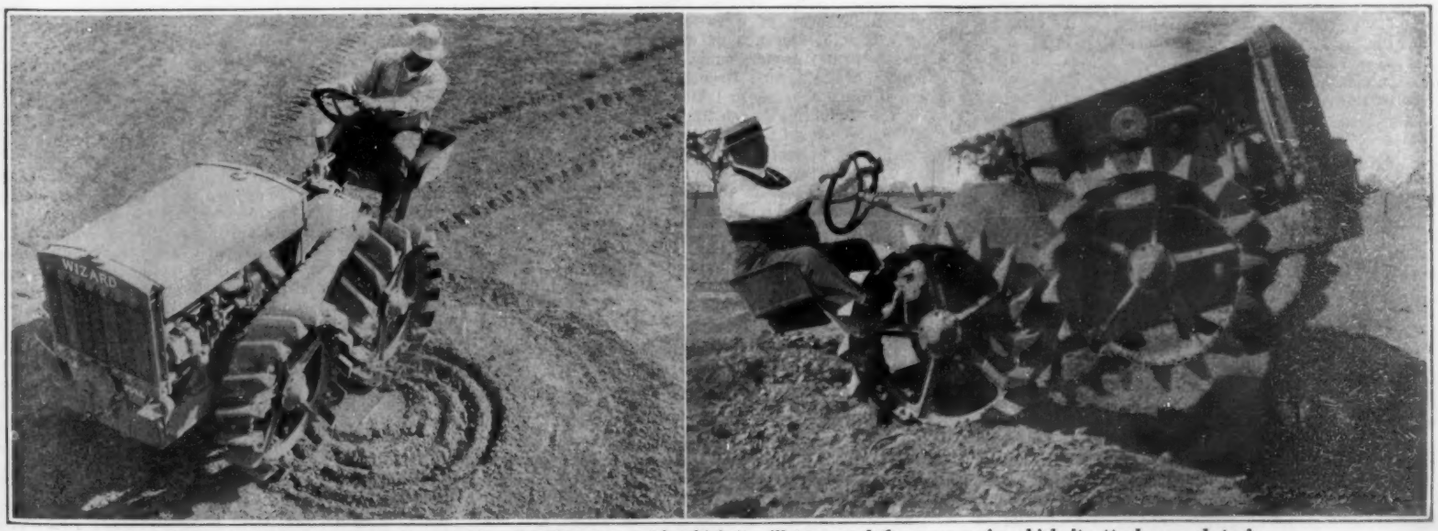
(C) The common type of metallic tubing, which depends for its tightness upon a rubber thread packing within the metal spiral. This rubber thread deteriorates with age, especially if overheated, causing small leaks in the tubing which might allow dangerous quantities of gas to escape, though not presenting much fire hazard.

(D) A very good grade of flexible tubing constructed of a gas-tight metal core covered with successive layers of paper, fabric, glue-glycerine compound, paper, and two braided coverings. It has the advantages of a metallic tubing of type (C) with some additional durability due to the superimposed layers.

(E) A very satisfactory type of tubing end piece if constructed of good quality materials. It consists of a threaded metal tail-piece, one end of which is screwed into the tubing and the other end is screwed into the rubber end piece, making the connection about as strong as the tubing itself.

(F) A common, but not always satisfactory, connection, consisting of a wood tail-piece glued into the tubing and rubber end. The gas passage is unduly restricted. The strength and durability depend upon the quality of glue used and the care with which the end is attached.

(Continued on page 510)



Two views of the new tractor, showing the sharpness with which it will turn, and the manner in which it attacks an obstacle

The Traffic Problem in New York City

Subway Extensions to Take Care of an Ultimate Annual Travel of Nine Billion Passengers

THE construction of adequate rapid transit facilities for the city of New York is rendered particularly difficult by certain special conditions which control the problem.

Foremost among these are: first, the unfavorable topographical condition that the heart of the city, to and from which traffic flows in the rush hours, is situated on the lower end of an island which is separated from the surrounding territory on the south by the broad waters of New York Bay, and on either flank by the wide and deep North and East Rivers; second, the vast population now amounting to nearly 6 million which is to be served; and third, the fact that the growth of travel takes place at a steadily increasing ratio.

Not only is the business center of Greater New York so far as regards transportation, pocketed at the southern end of Manhattan Island, but the great development in the number and height of tall office buildings has brought a corresponding increase in the density of the working population during business hours, with a corresponding added congestion of the transit lines.

Commencement of Rapid Transit

Rapid transit in New York City commenced about fifty-two years ago, or in 1868, and consisted in the first place of surface horse-drawn cars. These were supplemented about ten years later by the elevated railroads, and in 1904 the first of the subways was opened. It was not until the beginning of the present century that the city fathers began to get some glimmering of the stupendous problem which confronted them in the attempt to keep pace with the growth of population and business concentration in lower Manhattan, and the growing tendency for the business population to make their homes in the suburbs. At that time the streets were occupied by surface and elevated tracks and because of their noise and unsightliness it was realized that the public would never agree to the construction of additional elevated lines on Manhattan. Consequently, the only available field for enlargement was underground. Thus the idea of the construction of subways had its birth and an active campaign was carried on to enlist public sympathy and support.

The first subway system was opened in 1904, and it not only verified all the predictions of its sponsors, but was so successful that it carried a total number of passengers far in excess of the most sanguine estimates. Forewarned by the growing popularity of the subway, the rapid transit commissioners immediately formulated plans for its extension; but nothing material was accomplished until 1913, or nine years after the first subway was put in operation, and traffic had caught up.

The Dual Subway System

Then the so-called dual subway system was consummated and contracts were made between the city and the existing Interborough Rapid Transit Company and the New York Municipal Railway Corporation. The dual system, which practically doubled the trackage and trebled the capacity of the then existing rapid transit facilities, is very nearly completed, but its construction was greatly delayed and its cost practically doubled during the war. The whole system will carry about 2,400,000,000 passengers during the year 1920, and when the last extensions have been completed and everything is in full swing, it is estimated that it will accommodate about 3 billion passengers. Already, in spite of the increased facilities, the subways are heavily congested, and every citizen who uses them will agree that the city should push the system to completion with all possible dispatch, and in the meanwhile lay its plans for further extensions to meet the demands of the future.

An exhaustive study of this subject is found in a report by Daniel L. Turner, Chief Engineer, which has recently been submitted to John H. Delaney, the Rapid Transit Commissioner for this city. Mr. Turner's report is divided into two sections, one dealing with the requirements of the next twenty-five years, and the other with the probable needed extensions of the next seventy-five years, or, say, up to the close of the present century. The larger scheme is presented by the map and drawings found on the first page of this issue, but it should be carefully noted that it is not the intention, nor is it recommended, that the whole of this scheme should be put into execution at once, but only such parts of it as will be sufficient to meet the needs of the city up to the year 1945.

The estimates for 1945 and 1995 are based upon a study of the rate of growth of traffic during the present century, and particularly during the decade 1910 to 1920, and also upon the rate of growth of the population of greater New York. The figures represent the total travel of all systems of transportation, street-surface, elevated and subway. They show that in 1910 the total number of passengers on all systems was 1,527,000,000. This has increased to 2,400,000,000 in the year 1920, and if the growth in population and travel continues at the same rate, the city will have to provide for an annual travel in 1945 of 5 billion passengers, and in 1995 of over 9 billions.

Early Construction to Meet the Necessities of the Next 25 Years

The extensions which are recommended to be commenced immediately, and the work to be done in finishing up of the present dual system are as follows: Extension of Corona Branch of the Steinway tunnel line to Main Street, Flushing; also, on Manhattan, the extension of the Steinway tunnel line from Seventh Avenue and 41st Street west to connect with the proposed Amsterdam Avenue—Eighth Avenue Trunk line. A two-track extension of the present Broadway-Fourth Avenue line from 59th Street up Central Park West to the Harlem River; and extension of the Broadway-Fourth Avenue line from City Hall Park by way of Ann Street to East River to a connection with the Fulton Street elevated line near Ashland Place, Brooklyn. An extension of the Fourth Avenue subway, Brooklyn, by way of a two-track tunnel under the Narrows to the Borough of Richmond. An extension of the Nostrand Avenue subway to Coney Island. An extension of the Astoria Branch of the Steinway tunnel south through Queens and Brooklyn to a connection with the Brighton Beach line, thereby providing a Brooklyn crosstown line. A two-track extension of the Seventh Avenue-Broadway line from a point at Greenwich and Liberty Streets by Maiden Lane and the East River to Brooklyn, and thence by Hicks Street to a connection with the Culver line.

New Trunk Lines

In the Borough of Manhattan two additional trunk lines are to be built, one extending below Eighth Avenue and Amsterdam Avenue from 23d Street to 155th Street. This will be the most important trunk line of the whole subway system, for it will be a double-decked structure, four tracks upon each level. The immediate construction will include only four tracks of these eight.

There will be a collecting and distributing branch from 155th Street to upper Manhattan and the Bronx, by way of Fort Washington Avenue to Spuyten Duyvil, and thence by Netherland Avenue through the Riverdale section. From its southern extremity a branch will extend through 23d Street to the East River, and another branch will extend south down Hudson and Washington Streets to the Battery or South Ferry.

The immediate 25-year program calls also for a new East Side Manhattan trunk line, consisting of four tracks of what will ultimately be a six-track trunk line under Madison Avenue, reaching from 23d Street to the Harlem River and having a two-track collecting and distributing branch from 23d Street down Fifth Avenue and lower Manhattan to some point near Park Place.

Crosstown Moving Platform

The crosstown traffic and cross-over passengers from the East and West Side northerly to the West and East Side southerly portions of the various trunk lines are to be accommodated by moving platforms which, because of their great capacity, are well adapted to take care of this class of traffic where capacity is of more importance than speed. For the 25-year program there will be three moving platforms located respectively at 14th Street, 42nd Street, 57th Street, to be followed after the 25-year program is completed by others through 23d and 34th Streets.

Chief Engineer Turner's report states that it is impracticable to estimate the construction cost of this 25-year program because of the long period over which the work would extend. At pre-war prices it is estimated that the cost would be in the neighborhood of 175 million dollars, but at present prices the cost would amount to 350 million dollars. In all probability the cost will be intermediate between these two figures. In conclusion, we cannot do better than quote the final paragraph of this report, for upon the full recognition of the principles therein laid down, depends undoubtedly the success of our future transit operations.

"The new transit lines should precede the population. The new transit plan should be the basis of the city plan. Upon these two cardinal principles the future of the city depends. The foresight exercised in developing its transit facilities and in conforming its future expansion thereto will largely determine the prosperity of New York City in the years to come."

Do You Know That—

The transportation system of New York City—street cars, subways and elevated lines—carried 1,527,000,000 passengers in 1910.

These lines carried 2,400,000,000 passengers in 1920.

It is estimated that in 1995 they will be called upon to carry 9,000,000,000 passengers.

To accommodate the existing traffic there are, in addition to the elevated and surface lines which hardly admit of extension, 616 miles of single-track subway and 34 tunnels beneath the waters about the city.

To accommodate the traffic of 75 years hence it will be necessary to build 830 miles of new single-track subway and 42 new sub-aqueous tunnels.

At present prices, so much of this program as is likely to be called for by the traffic needs of the next twenty-five years will cost some $350,000,000.

Such is New York's rapid transit problem.

Radio-active Pottery

A NEW method of applying the well-known healing properties of radium is reported in a German magazine. Many natural waters have been found to be radio-active and their presence in the springs of certain resorts has undoubtedly occasioned or added to the fame of these, but it has been discovered that any kind of water can be made radio-active by the action of radium, consequently some one has had the ingenious idea of simplifying this process by making jugs and other vessels of radio-active clay. It has been found that certain clays employed in the manufacture of pottery readily lend themselves to a mixture with radio-active substances without injury to their ceramic qualities, especially the property of being readily molded and fired. The most important radio-active substances employed are the uranium pitchblend which is found in considerable quantities in the Joachimstal in Bohemia, and the mineral called Fergussonite, as also the residues remaining from the working of uranium ores.

These substances are mixed with the clay which is then molded into the desired shape and fired. Certain precautions must be observed, however, during the firing—in especial the clay must be prevented from becoming too much vitrified and contracting too greatly. It must, on the contrary, preserve as large as possible an external surface and thus remain porous in the interior. This is accomplished by a suitable modification of the firing process. The vessels thus prepared are first sprayed with fused aluminum and then receive a thicker layer of metal (copper or brass). When water is poured into a jug thus prepared it becomes highly radio-active in the course of a few days. Instead of jugs clay tubes can be manufactured in the same manner and simply slipped into ordinary drinking vessels. The radio-active water obtained in this manner is used not only as a curative agent but it is suggested that it be employed for the watering of plants, since it has been discovered that radium is favorable to the growth of vegetation.

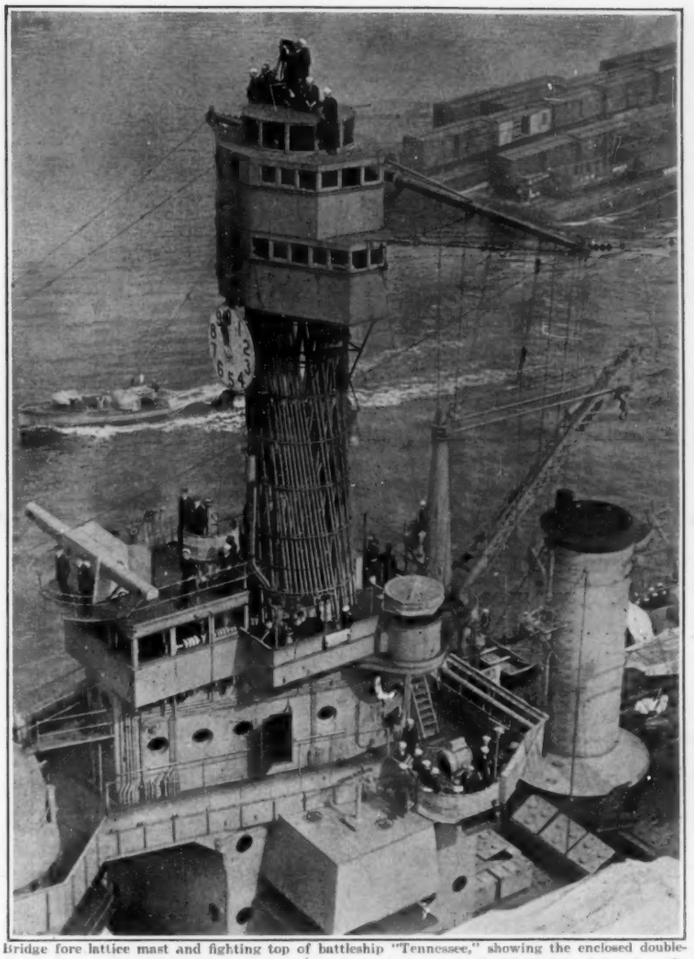
"Tennessee"—Our Latest Battleship

A Ship Which Embodies Many of the Tactical Lessons of the War

THE battleship "Tennessee" (sister to the "California") which was laid down at the New York Navy Yard in May, 1917, recently left for a "shaking down" cruise to Guantanamo, Cuba, at the conclusion of which she will be given her speed trials for acceptance by the Navy Department. Her principal dimensions are: length between perpendiculars, 600 feet; beam, 97 feet, 3½ inches; mean draft, 30 feet 3 inches; normal displacement, 32,300 tons; and full load displacement with 31 feet of draft, 33,190 tons. Her motive power consists of a Westinghouse turbo-electric drive, with two main generators and four propelling motors. In the boiler room are Babcock and Wilcox oil-fired boilers, and her estimated shaft horse-power is 38,500. The main battery consists of twelve 14-inch, 50-caliber guns which are emplaced in four 3-gun turrets, all of which are mounted on the center line of the ship and are available on either broadside. The secondary battery, which is mounted in casemates on the spar deck, and upon the boat deck, consists of fourteen 5-inch, 51-caliber guns. For anti-aircraft defense there are four 3-inch guns. The "Tennessee" mounts two torpedo tubes, one on each beam, for firing the 21-inch torpedo. The complement of the ship is made up of 130 officers of all ranks, and 1,281 men. An unusually large part of the displacement of the ship is given over to armor protection, the belt having a maximum thickness of 14 inches. The funnel bases are heavily armored. The port plates of the turrets are 18 inches in thickness.

A great deal of thought has been given to protecting the ship by limiting the inflow of water below water line, caused by shell fire or torpedo. Between the outer shell of the ship and the engine and boiler rooms, magazines, and other vital elements, there are several longitudinal walls of steel which are intersected by numerous transverse bulkheads. This provides the ship with a wide cellular belt, whose effect will be greatly to limit the flooding which results from the successful blow of a torpedo. Also, the vitals of the ship are protected from shell fire by several stout steel decks which, it is hoped, will serve as shell-bursters and by breaking up the shells prevent any penetration below the protective deck.

During the service of our Sixth Battle Squadron, with the Grand Fleet in the North Sea, there was a very free exchange of ideas between our own and the British navies, as there was also between the various departments of the two navies, and when our squadron returned to this port they presented to American eyes several new features which they had brought with them from the area of naval operations. Several of these features have been embodied in the "Tennessee," with many improvements worked out in our own department. Among our own developments is the large enclosed structure at the mastheads which takes the place of the old, open, fire-control platforms as they were known in our navy in pre-war days. These enclosed "tops" were necessitated by the improvements in director firing, in which the aiming of the guns is controlled by officers stationed in lofty positions and preferably at the masthead.



Bridge fore lattice mast and fighting top of battleship "Tennessee," showing the enclosed double-deck structure in which the directorscope and the instruments for finding and keeping the range of the enemy and his bearing are housed, together with the fire-control personnel. Note the close massing of the latticed tubing, to ensure rigidity.

The new-type fighting top of the "Tennessee"

In no direction has there been such progress as in this matter of gunnery. Both in the British and in our own navies some really wonderful instruments have been devised for finding the range and bearing of the enemy and keeping on the range in spite of the deviation of one's own or the enemy ship. Among these may be mentioned range-finding instruments, target bearing instruments, and those for range keeping; and, of course, there is the form of telescope known as the directorscope. It has become necessary to give ample protection both to these instruments and the officers and men who operate them. This accounts for the remarkable double-deck structure which is such a conspicuous feature at the head of each of the lattice masts of the "Tennessee." It will be noticed, by the way, that these masts are very much more massive in construction than those of our earlier ships. This change is due to the necessity of damping out as quickly as possible the intense vibrations which are set up in the structure of a battleship and particularly at the mastheads, when a salvo from its big guns is fired. Also, it is desirable to reduce to a minimum a certain amount of springing of the masts, due to inertia when the ship is rolling or plunging heavily. The British use a combination of three very stout steel masts arranged in tripod form. Doubtless, this gives a stiffer platform; but in the opinion of our Navy Department, the tripod mast could be more easily shot away or seriously disabled than our lattice masts, which are made up of a very large number of spirally grouped steel tubes.

Another development of the war is the use of director firing, not merely for the main battery, but also for the 5-inch torpedo battery. These, of course, have to be separate installations and hence we have the two separate director rooms, one above the other.

Another conspicuous feature which will be new to American eyes is the large clock face at the front of the foremast. This is a British device which gave satisfaction. It is used when a fleet is steaming in column to indicate to the ship ahead and the ship behind (there is another clock on the rear of the main mast) the speed at which the ship is traveling—a necessary precaution in keeping proper distance and station. At the foot of the foremast and some distance ahead of it is a large covered range-finder, and below this is the navigating bridge. Below the bridge where we see the circular port holes is the chart house which is surrounded by the signal bridge. A group of signal men will be noticed in the right-hand corner of this bridge, with the racks for the signal flags behind them, and the signal halyards leading up to the signal yard at the top of the mast. Forward on this bridge will be noticed the top of the conning tower.

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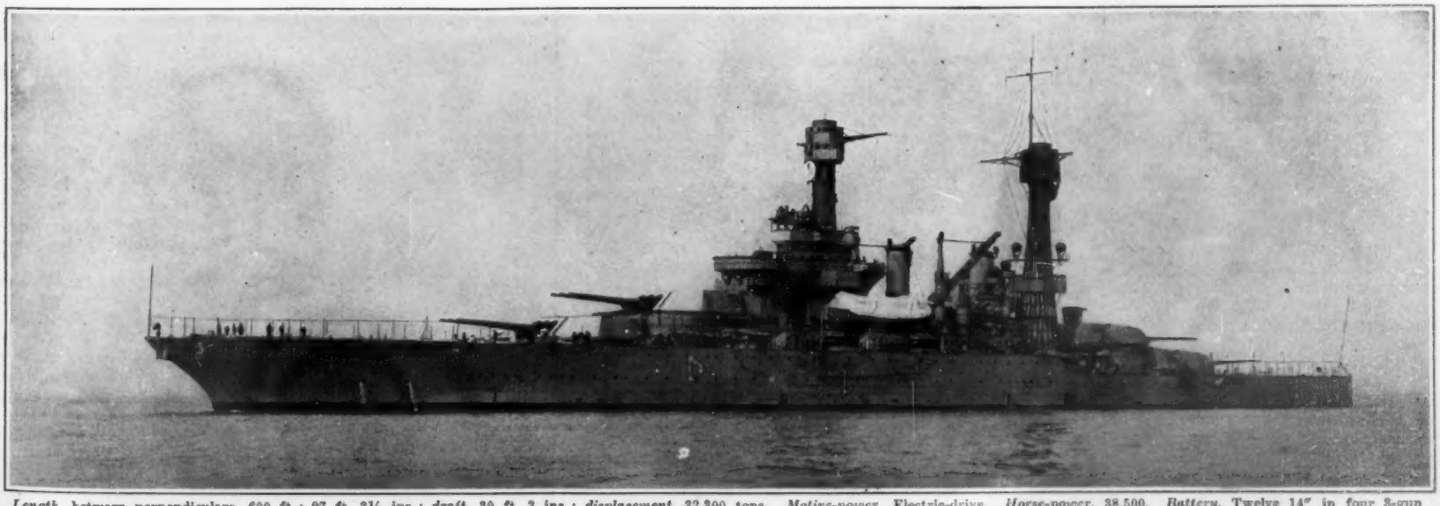
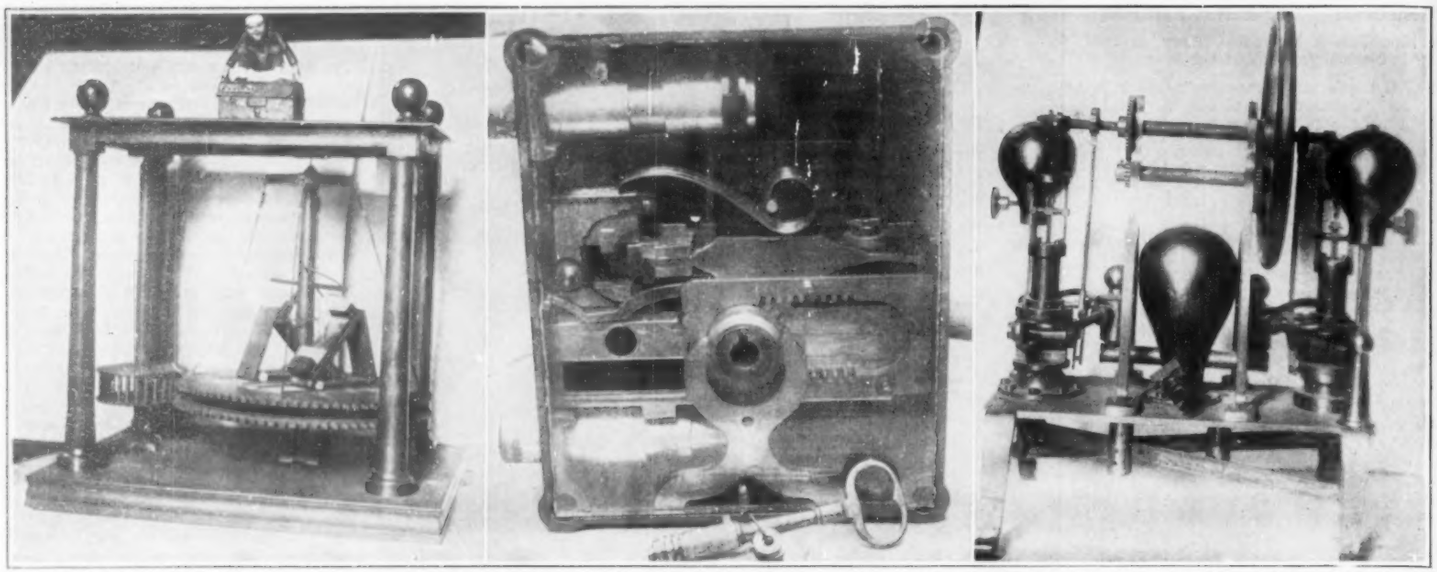


Length, between perpendiculars, 600 ft.; 97 ft. 3½ ins.; *draft*, 30 ft. 3 ins.; *displacement*, 32,300 tons. *Motive-power*, Electric-drive. *Horse-power*, 38,500. *Battery*, Twelve 14" in four 3-gun turrets, fourteen 5". *Armor*, belt, 14"; turrets, 18". *Complement*, 1,411 officers and men.

Our latest battleship "Tennessee," leaving New York for a shaking-down trip, preparatory to her trials



Left: Original of a perpetual motion machine made by Charles Readheter in 1810 and now in the Institute museum. *Center:* Original model of the Yale lock, on exhibition at the Franklin Institute. *Right:* Original of the famous Keeley perpetual motion motor, against which the SCIENTIFIC AMERICAN waged a winning fight

Three interesting items from the museum of the Franklin Institute, one of which had the Institute's endorsement

First Aid for Inventors

The Franklin Institute and the Committee Through Which It Assists Meritorious Patents

By William A. McGarry

UNKNOWN inventors storming the citadel of fame with brains and mechanical or scientific ingenuity too often discover that these resources are of relatively little value in finding a market for their achievements. It has been said that the hardest part of the inventor's work begins after he has obtained his patent, when he starts the weary grind from office to office seeking financial backing to commercialize the product.

Yet for nearly a century one of the world's most famous scientific institutions has maintained a corps of experts "to examine and make report upon all new and useful machines, inventions and discoveries submitted to them." The individual services of the members of this corps command anywhere from ten to a hundred thousand dollars a year, and the wealthiest corporation in the country would go bankrupt if it tried to hire all of them. But inventors may have their advice for the price of postage stamps.

These men are the members of what is now known as the Committee on Science and the Arts of the Franklin Institute, founded in 1824 at Philadelphia as a memorial to Benjamin Franklin and for the promotion of the mechanic arts. Free scientific examination of appliances and processes was one of the first functions of the institute. In the beginning the work was done by a "Board of Examiners." Later it was turned over to a "Committee on Inventions," and in 1834 the present committee was established. Until 1886 membership on the committee was open to any member of the institute, but in that year it was decided to limit the body to forty-five members "who shall pledge themselves by their acceptance of membership to perform such duties as may devolve upon them, and to sustain by their labors the scientific character of the institute." Still later the number was increased to sixty members.

The work of this organization in behalf of inventors is not intended to provide easy access to unlimited capital, but that, in effect, is what it does when an invention is of sufficient importance to warrant even a favorable mention. When the appliance or discovery means as much to the mechanic arts and to society at large as Moissan's electric furnace, Owens' bottle-blowing machine, Pupin's discovery of the art of reducing attenuation of electrical waves and apparatus or Turner's air brake, to mention a few random items out of hundreds, the committee is empowered to award the Elliott Cresson gold medal and other similar honors.

In general, however, it may be said that these higher awards are for contributions to the world's store of knowledge that the unknown inventor rarely makes with his first achievement. To obtain the committee's certificate of merit it is not necessary that the inventor be a distinguished man of science. And from the financial point of view this certificate is just as valuable to him as the Franklin Medal, which is awarded to scientists of international repute like Marconi, one of the winners last year.

Publication of the award is made in the journal of the institute, with the result that within a few months the invention is brought to the attention of every large corporation in the world maintaining a research laboratory, every organization of scientists and all the best technical schools and colleges. The records of the institute show that by far the greater proportion of the discoveries recognized by its Committee on Science and the Arts or its predecessors in ninety-six years have come into wide commercial usage within a relatively short time. With the approval of the experts on this committee for his achievement it is no exaggeration to say that the inventor may make his own selection of capital offers, instead of being compelled to spend his time seeking to enlist financial aid.

Only one thing is necessary for the inventor who seeks this approval—he must have something of real value. It is not essential that it be in use. For obvious reasons, the institute will not consider an invention until a patent has been granted, nor will it act where a patent is in litigation except where this action will not infringe on the rights of either party. The regula-

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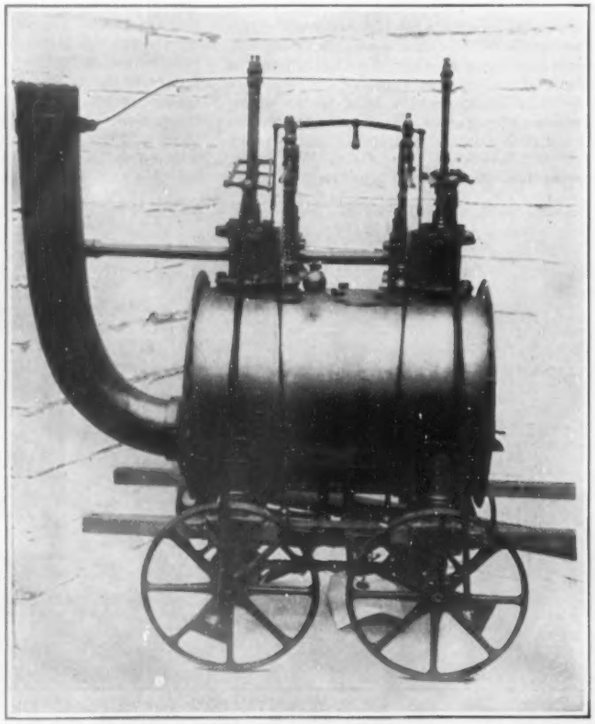
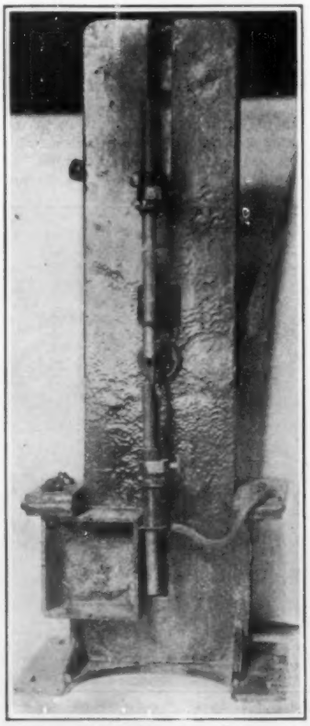
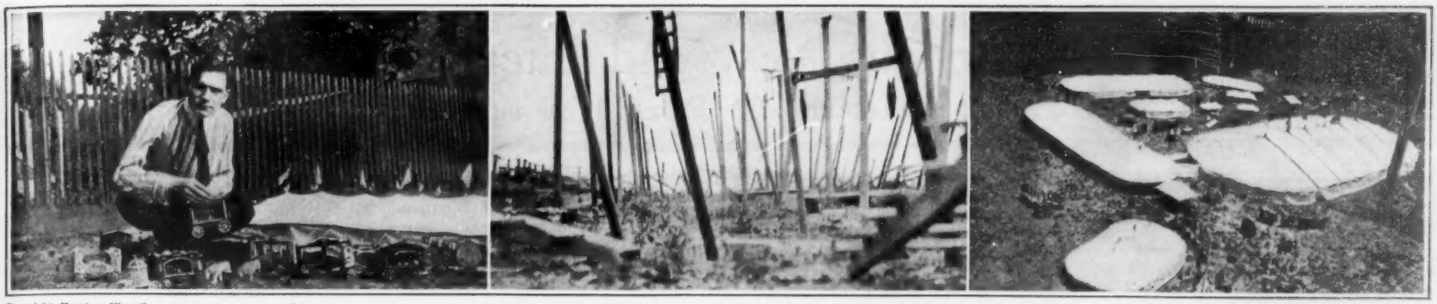


Model of the Stephenson locomotive, to be seen in the Franklin Institute museum



The original Brush carbon arc light



 Three views of the miniature circus, showing the owner and the menagerie, interior of big top, and a bird's-eye view of the entire plant

The Circus in Miniature

OF miniature sailing vessels, steamers, electric and steam locomotives, houses, gardens, skyscrapers and so on, there seems no end. But when it comes to the circus in miniature, it appears as though we have hit upon something a little out of the regular run of model work.

Here is a young model maker who has constructed a remarkable miniature circus. The first of the accompanying views shows the menagerie tent and the owner of the show, together with some of the cages. The present plant has 60 wagons all told, including baggage, parade, official, cages, and so on. The owner plans to increase his circus to 85 wagons for the 1921 season.

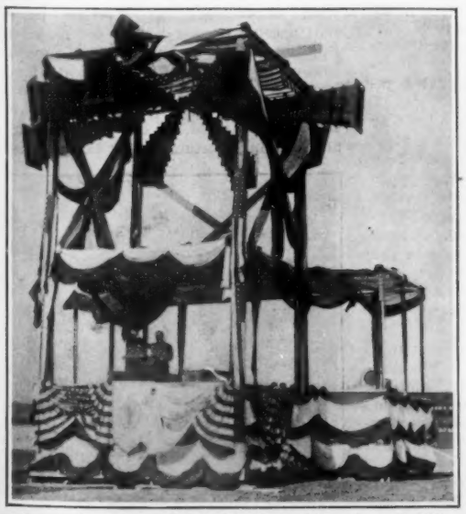
The second view shows the interior of the big top. The center poles are 16 inches high. This tent contains a hippodrome track, three rings, two stages, and aerial apparatus. There are general admission seats, reserved seats, and a grandstand. Three hundred stakes are required to hold this tent.

The third view is a bird's-eye view of the entire circus. In the immediate foreground is the side show. Beyond it is the marquee, or entrance, which leads into the menagerie tent. At the right is the big top, which measures 6 by 12 feet. Other tents are the horse or stable tent, dressing tent, two smaller private dressing tents for star performers, blacksmith tent, cook-house and dining room.

The Voice with the Megaphone Wins

REMARKABLE progress has been made ever since the Liberty and Victory Loan drives in the art of addressing large gatherings. Not so many years ago a public speaker was limited to a crowd of but a few thousand persons when speaking in the open air. Today, thanks to the various amplifying systems and loud-speaking telephones now being employed, a speaker can address 50,000 persons without difficulty.

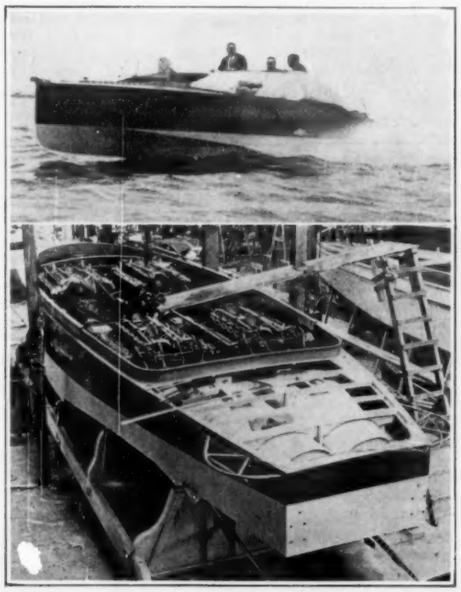
A remarkable installation of loud-speaking telephones and megaphones is shown in the accompanying illustration. Here is the speaker's stand recently built in Boston for political purposes. The speaker's voice is gathered by an arrangement of microphones in front of him, amplified by vacuum tube circuits, and propagated by means of the loud-speaking telephones and megaphones in all directions. This system of centralized distribution is generally better than the method making use of numerous scattered loud-speaking units.



A speakers' stand suitable for addressing 50,000 persons in the open

The Highest-Powered Motor Boat Afloat

IT will be remembered that one of the contestants built for the Harmsworth Cup races was "Maple Leaf V," owned by Sir E. M. Edgar. In the races she was piloted by H. G. Hawker, who, it will be remembered, made an unsuccessful attempt to fly from Newfoundland to Ireland. We publish these pictures of the boat because of the enormous power plant which was



Two views of the "Maple Leaf V," which has a combined horse-power of 1,800

crowded into her; for although she is only 39 feet in length, it was found possible to crowd into her four 450-horse-power Sunbeam engines, together with the tanks of large capacity which were necessary to carry the fuel. One of our pictures shows the four engines placed in pairs side by side. So big was the power plant that it was difficult to find room for the crew's quarters.

The "Maple Leaf," in spite of the fact that she carried twice the horse-power, was easily beaten by "Miss America," which on a length of 26 feet carried only two Liberty engines of a combined horse-power of 800, or less than half the horse-power of "Maple Leaf V." The best speed made by "Maple Leaf" was during her trials, when she reached 62.4 miles per hour; "Miss America" was credited with having made 71.4 miles per hour and was much easier to handle when racing than her rival.

A New Engine

A LA RHONE engine, made of Sheffield steel, has been presented to the Sheffield University. W. H. Allen, the donor, stated that the engine, although of French origin, is to be made in England by request of the British Government, and the output has been increased from 3 to 50 a week. Altogether 3,000 La Rhone engines have been turned out by the British manufacturers.

The engine is a 9-cylinder rotary type, weighing less than 3 pounds per horse-power. The purpose of the engineers is to produce an engine developing 2.5 horse-power per pound of weight. The La Rhone engine is said to be of startling design. At 1,300 revolutions per minute it develops 100 horse-power, though it can stand on a small drawing table. Dr. Ripper, of the engineering department of Sheffield University, predicts that the next step will be the development of a gas turbine running at a higher revolutionary speed with greatly reduced weight per horse-power.

Front-Wheel Drive

A MOTOR car improvement, which makes possible the driving of the car from the front instead of the rear wheels, has been invented by G. I. Hoskins, of Sydney, Australia. J. I. Brittain, American consul at Sydney, gives an account of the invention in a report to the State Department.

Mr. Hoskins claims that his invention is a positive success and prevents skidding. A test over 16,000 miles of rough road has been made, it is claimed, with no signs of wear. A number of patents have been taken out.

The front wheels are pivoted in the center, which enables the steering of the car with much greater ease than in the rear-wheel-driven machine. The device is now attached to an old worn British car which, prior to the attachment of the device, weighed 32 hundredweight, with a speed of 38 miles an hour, traveling 15 miles on one gallon of gasoline. After alteration and application of the front drive device, the car weighs 35 hundredweight, has a speed of 45 miles an hour and will go 17½ miles on a single gallon of gasoline.

An Interesting Pole Construction That Turns Transmission Line

AN interesting pole rack has been constructed for turning a transmission line along the St. Joseph River in Michigan. Spanning the river at this point the transmission line is supported on one side by strain insulators attached to the hydro-electric power house and by a rectangular tower on the other. The lines are turned parallel to the river a short distance beyond the steel tower by means of a wooden tower of four poles formed in a square. A strain tower was erected beyond the corner tower so that the main line strains would not be carried by the wooden structure. The corner tower is, in reality, only a support of splices between the lines running at right angles from this point. Each arm supporting a conductor is guyed back to a short stub pole set and anchored beyond the corner tower, and not shown in this view.

This wooden structure serves to support the power cables at the point where they turn

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Serving as a side car, the canoe may be transported anywhere in quick time

A Canoe That Goes Anywhere

SOMEWHAT out of the ordinary is the canoe-carrying motorcycle shown in this photograph which comes to us from England. An ingenious young man, Mr. Armstrong, who served in the Royal Air Force as an experimental airman, designed and constructed the arrangement shown in this picture for the purpose of carrying his canoe to distant waterways. The canoe, it will be noted, also serves as a side car for carrying one or two passengers and luggage. An arrangement of helical springs makes this exceptional side car easy riding.

Taking the Hard Work Out of Threading Pipe

AT best, and that means with the finest tools hitherto available, the threading of large pipes has been a slow and laborious kind of work. The necessity of doing this work "on the job" has prevented the introduction of the usual machinery, and the workers have had to cut threads with stock and dies.

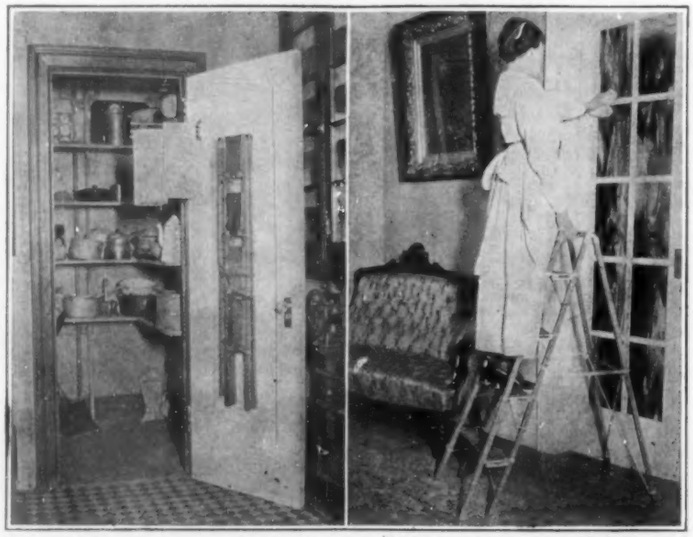
Now comes a Toledo, Ohio, concern with an electrically-driven machine for threading pipe. This machine, which is shown in the accompanying illustration, is a highly portable affair so that it can be used "on the job," even when said job is a relatively small one. The machine consists of an electric motor mounted on a two-wheeled truck, a suitable transmission system which can be adjusted to work at any angle, and the screw-cutting member. It is said that a 12-inch thread which would take two hours and two men to cut by hand, is now completed with this machine in 15 minutes and with one man.

Electrically-driven thread-cutting machine which does the work of two men in one-eighth the time

A Household Ladder That Is Never in the Way

EVERY household requires a ladder. Unlike most other pieces of furniture or equipment, the ladder is required only once in a while, but when it is required the need for it is so great that serious inconvenience results in the absence of it. Again, when it is not required, which means something like ninety-nine one-hundredths of the time, it must not be in the way.

With those facts recalled to our attention, we are ready to appreciate the ingenious ladder recently developed by an American inventor. This ladder may be completely folded up and fastened to the back of a closet door, as shown. When set up, ready for use, it is exceptionally rigid so that the housewife need not fear using it. Unlike the usual convertible chair and ladder, which, while it serves two functions, is a poor chair, the new ladder remains rigid and outlasts several of the former.



This little ladder is exceptionally strong and rigid, yet may be folded flat and fastened behind a closet door, out of the way

Discovery of Iron Ore in Switzerland

THE Federal Council officially states that the Society of Study, founded in 1918 at the instigation of the Federal Department of Economics, has by explorations and excavations in the Frickthal, a valley in the northern part of the Canton of Aargau, recently discovered an area of 190 hectares (hectare = 2.47 acres) containing 15,000,000 tons of iron ore. In the immediate vicinity, not yet surveyed and excavated, there is estimated an additional amount of 22,000,000 tons. One can realize the importance of this discovery, it is stated, if it is understood that these millions of tons will assure to Switzerland, at pre-war consumption rate, sufficient iron ore to last for 45 years. The Federal Council suggests a provision by the Government of 1,200,000 francs upon condition that a total capital of 4,000,000 francs is raised for exploitation.

Barrels Made of Paper

FARMERS and manufacturers have felt the ever-increasing cost of barrels, and it has been pointed out on more than one occasion that barrels are playing no small rôle in the general high-cost-of-living scheme.

For some time inventors have been at work on the barrel problem with a view to producing cheaper containers. Several of them have tackled the paper barrel problem and it appears as though their work has finally materialized into something of practical value. These paper barrels are generally made in the form of many layers of stiff paper, held together by some suitable adhesive which may also be watertight and weatherproof.

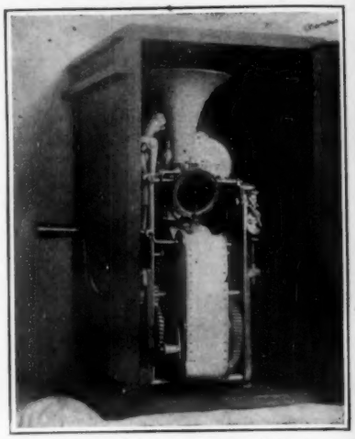
The barrel shown in the accompanying illustration is made by a winding process employing chip board, and is said to cost one-third less than a wooden barrel of equivalent size. The inventor also claims greater strength for this paper barrel.

Paper cans and other containers can be made of wound paper, and no doubt much will be done along this line in the near future.

A Clock That Speaks For Itself

FOR seven years Mr. H. Hartmann, a New York inventor whose name is no doubt familiar to many of our readers by reason of his several past inventions which have been described in these columns, has been using the clock shown in the accompanying illustration. So it is apparent that this clock has a rugged and lasting mechanism, and is out of the experimental class.

The clock in question is a speaking clock; that is to say, it speaks every fifteen minutes, announcing the correct time. The voice record is carried on a band of film which is perforated in much the same manner as the standard motion picture film. A conventional phonograph reproducer is used to translate the latent sound record into actual sounds. Pressing a button causes the clock to repeat the time, while another button keeps it silent. The clock is only 16 inches high, 10 inches wide, and 9 inches deep.



This clock has neither dial nor hands; it speaks the time like a phonograph

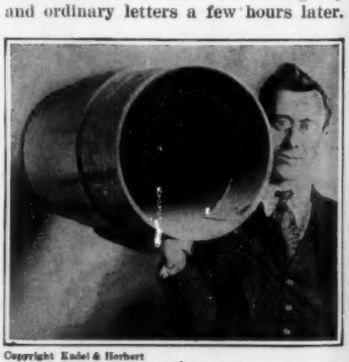
Commercial Aviation in England

IN the fifteenth annual report of the British Meteorological Committee plans were brought forward to secure a comprehensive service of weather reports to facilitate commercial aviation and to forecast accurately aerial conditions affecting the London-Paris-Brussels service.

The plan has in its purview the establishment of approximately 20 distributing centers, staffed by trained meteorologists, who will provide regular information covering the following points:

1. Wind at surface and at 2,000 feet
2. Weather (present and past in general terms).
3. Amount and height of any low cloud.
4. Visibility.
5. (For seaplanes.) The state of the sea, particularly in regard to the nature and amount of the swell, which affects the power of a machine to rise.

During the past month the Swedish post office has announced a regular air service from Stockholm to Malmo, Copenhagen, Hamburg, Bremen, Amsterdam, and London, and the service known as the London-Copenhagen Air Mail, recently inaugurated for service to London via Hamburg and Amsterdam, with Copenhagen as starting place, will accept express letters for distribution in the afternoon following the morning of departure at Berlin and Hamburg, and at night in Amsterdam, while express letters will be delivered in London at 2 P. M. on the following day and ordinary letters a few hours later.



Eleven-gallon barrel made of paper and costing one-third as much as a wooden one

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

GARTER.—P. E. ROSEN, 117 W. Main St., Madison, Wis. The invention has for its object to provide a device especially adapted for men's use, wherein the garter consists of a strip of non-elastic material having at one end a clasp for engaging the hose and having near the other a loop through which the clasp is adapted to be passed to form a sliding loop for encircling the leg at the knee to provide a support which will accommodate itself to the movement of the muscles to properly support the hose.

Pertaining to Aviation

GIRDER AND THE LIKE FOR AIRCRAFT.—E. E. BROWN, c/o D. J. Mooney, Steel Wing Co., Ltd., 48 a Gallingham St., London, S. W., 1, England. The invention has for its object to provide a metal girder or equivalent structure for aircraft which shall be very stiff and stronger in proportion to its weight. The girder comprises composite channel members placed back to back, characterized by the web portion being provided with parallel ribs which are set obliquely to the longitudinal direction of the girder, the ribs of one channel member being sloped in the opposite direction to those of the other which increases the parallel resistance.

METAL CONSTRUCTION.—E. E. BROWN and D. J. MOONEY, c/o The Steel Wing Co., Ltd., 48 a Gillingham St., London, S. W. 1., England. The invention relates to a metal frame device for use in connection with airplanes. An object being to provide a spar composed of sheet metal which will embody the maximum of strength and at the same time be as light in weight as is possible consistent with the use.

Electrical Devices

RELAY ARMATURE.—J. I. MITCHINER, 78 S. Pryor St., Room 401, Atlanta, Ga. An object of this invention is to provide a telegraphic relay armature of such a construction that two or more electrical contacts are simultaneously made in separate circuits upon the energization of the relay magnet. Another object is to provide an armature by which the making of one contact in each of two separate circuits simultaneously is enabled to be made without the aid of supplementary springs.

DEVICE FOR ATTACHING ELECTRIC LIGHT FIXTURES TO OUTLET BOXES.—R. BATTLE, Box 859, Okmulgee, Okla. This invention has for its object to provide a device of the character specified, so constructed that the fixture, as for instance a light or fan, may be readily removable for inspection, repair, interchange, cleaning and the like, and adapted for use on either ceiling or side wall.

LAMP FIXTURE.—J. S. PENNEFATHER, 500 W. 144th St., New York, N. Y. The invention relates more particularly to an adapter used for the purpose of converting a vase into a base for supporting an electric light and shade fixture. An object is to provide an adjustable adapter to fit various forms, shapes, sizes, and heights of vases, which may be readily mounted upon a vase, and which will be ornamental in appearance.

Of Interest to Farmers

CULTIVATOR.—R. L. GUTHRIE, R. 3, Box 409, Santa Rosa, Cal. This invention relates particularly to hand-operated cultivators of the wheel type, an object being to provide means for connecting the standards and braces of the structure to the frame supporting the same, whereby the parts may be easily and quickly adjusted or rearranged to perform the desired functions.

MAIZE OR INDIAN CORN HARVESTING MACHINE.—E. LOGAEZO, Buenos Aires, Argentina. The invention is characterized by the special construction and arrangement of the husking means constituted substantially by a pair of biconical cylinders placed at an angle, and the surface of each of which is grooved or fluted in parallel direction of its axis, or in a helicoidal direction. The movement of the machine is obtained by means of a gearing driven by the axle of the transportation wheels.

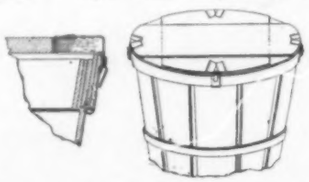
Of General Interest

LIFEBOAT.—G. DORFFEL, 2141 S. 47th St., West Seattle, Wash. The invention relates to lifeboats or escape buoys for use with submarine vessels. The object is to provide a device which can be easily and quickly launched, which is carried in position by the submarine vessel so that interior access can be had at all times before launching, and which will not unfavorably affect the normal operation or maneuvering of the submarine vessel.

COFFEE POT.—W. H. BRUNING, 100 Upper 1st St., Evansville, Ind. Among the objects which the invention has in view are to avoid radiation of heat during the process of making coffee, and of radiation of heat from the coffee subsequent to the making thereof, to distribute water poured over the prepared coffee, to equalize the filtration thereof, to provide means for maintaining by diffusion the heat of the liquid coffee, and to construct a coffee pot arranged to afford easy access for the purpose of cleaning.

PRODUCT IMITATING CHINA.—C. BUTTY, Calle Maipu 671, Buenos Aires, Argentina. This invention is adapted to be used as an imitation of china, marble and the like; it is not affected by acids or changes in weather, and in consequence is particularly suitable for the manufacture of buttons, insulators, objects of art, etc., and other articles not destined to get in contact with fire. The composition is as follows: Sulfur, 40 per cent; clay or Roman cement, 60 per cent, and a coloring matter.

BASKET FASTENER.—J. F. KENNEDY, 9 Laurens St., Charleston, S. C. The invention relates generally to fruit and vegetable baskets and more particularly to the fastenings thereof, an object being the provision of a



A PERSPECTIVE VIEW OF BASKET WITH COVER SECURED

simple and inexpensive means capable of ready use without the necessity of driving fasteners in the basket cover, as well as a fastener which may be speedily applied and will be effective in use.

COMBINED PERISCOPE AND GUN.—L. HOLECEK, 652 7th Ave., Oakland, Cal. An object of the invention is to provide a combined periscope and gun for submarines, to permit of accurately swinging the gun to correctly aim the gun at a distant object as seen through the periscope. Another object is to permit of firing the gun when the submarine is in submerged, raised or awash position, and to permit the gunner to swing the gun up or down to obtain the desired elevation or depression.

PURSE.—W. STONE, 66 W. 36th St., New York, N. Y. An object of the invention is to produce a coin purse made in conjunction with a hand bag and thus combining the advantages and facilities of both, a large hand bag and a small coin purse. One of the primary objects is to provide against the necessity of carrying both hand bag and coin purse in order that a lady may be equipped with an article which will materially facilitate the payment of car fares and other small change in crowded places.

Hardware and Tools

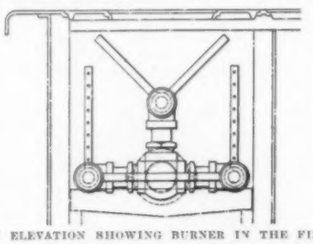
MILLING CUTTER.—W. A. JAMES, c/o Ellis Spear, Jr., Tremont Bldg., Boston, Mass. A specific object of the invention is the provision of a milling cutter in which certain of the tool elements are set at an angle to the axis of rotation, while others are parallel with the axis, so that when the disks are moved axially, one with respect to the other, all the disks are effectively clamped or unclamped.

CENTERING PUNCH.—H. M. WALKER, Benford, Texas. This invention has for its object to provide a device having means for permitting the punch to be accurately centered in an opening of a pattern plate for instance, to insure that the punch will engage the work at the exact center of the opening, and wherein the punch is adjustable for openings of various sizes.

OVERSHOT.—R. A. DAILEY, c/o Honolulu Cons. Oil Co., Taft, Cal. The invention has for its object to provide a device adapted for fishing broken tools from a well casing, wherein a body portion is provided having slips or dogs for engaging the tool to hold the same, together with various types of interchangeable bowls for facilitating the engagement of the overshot with various characters of break.

Heating and Lighting

GAS BURNER FOR HEATERS.—R. DEPEW, 1485 DeKalb Ave., Brooklyn, N. Y. The object of the invention is to provide a gas burner for use in the firebox of a kitchen range, house-heating furnace and similar heater, and arranged to insure the production



AN ELEVATION SHOWING BURNER IN THE FIREBOX OF A KITCHEN RANGE

of a high heat with an exceedingly economical consumption of gas. Another object is to provide a gas burner of simple construction which can be readily installed in a firebox without requiring alteration of the same.

Machines and Mechanical Devices

COAL HANDLING MACHINE.—E. N. WEAVER, 98 Columbus Ave., Jersey City, N. J. Among the objects of the invention is to provide mechanism for rapidly handling, sizing, and transferring bulk material such as lump coal in regulatable quantities from one ship or conveyance to another, as for instance, in the rapidly coaling of ships through a chute into the lumber hatch, thus dispensing with the necessity of employing many laborers.

CARGO HANDLING APPARATUS.—J. G. GUNN, Cherokee, Iowa. An object of the invention is to provide a cargo handling device by means of which cargoes may be quickly and easily transferred from place to place and the cargo dumped or unloaded expeditiously in any place and manner desired by the mere operation of a crane or other lifting device employed.

STEAM CIRCULATING BY-PASS AND RELIEF VALVE.—E. B. WHELAN, 1025 S. 10th St., Omaha, Neb. The invention relates generally to valves for steam engines, especially locomotives and particularly to valves which function as by-pass and vacuum and compression relief-valves, the object being the provision of an arrangement whereby low pressure steam is positively circulated through the cylinders when a locomotive is drifting for the purpose of lubrication, in addition to the usual functions of a valve of this type.

MOTOR.—J. SCHROEDER, 1624 W. 7th St., Davenport, Iowa. An object of the invention is to provide a valve gear comprising a shaft and means for turning the shaft in opposite directions, a crank disk loose on the shaft, means for compelling the disk to turn with the shaft during a portion of the rotary movement in both directions, a spring operatively connected to the disk and compelling the latter to complete its movements, a valve operating crank arm, and a rod connecting the disk and crank arm.

Musical Devices

SOUNDING BOARD FOR MUSICAL INSTRUMENTS.—J. VIZZI, 341 E. 124th St., New York, N. Y. The invention has particular reference to sound boards for such instruments as violins, violas, cellos, pianos or the like in which there is ordinarily used a sound board as a means amplifying the sound vibration. Among the objects is to provide an auxiliary sounding board arranged in spaced relation to the main sounding board of the instrument and having the periphery thereof disconnected from all other parts of the instrument.

ARTICULATOR FOR PHONOGRAPHS.—F. B. LONG, 833 Market St., San Francisco, Cal. The object of the invention is to provide the sound chamber of a phonograph into a sound board of a highly vibrant material and subjected to edgewise pressure to form a crown on the sound board with a view to insure perfect vibration. Another object is to throw back upon the sound board the molecular vibrations emanating from the sound board.

Prime Movers and Their Accessories

ATTACHMENT FOR INTERNAL COMBUSTION ENGINES.—W. E. STITZER, Box 299, Muskogee, Okla. The object of this invention is to provide mechanism for use in connection with lubricator and controller by the level of the oil in the lubricator, for stopping the motor when the oil falls below a predetermined level, by short circuiting the ignition system.

VALVE SPRING COMPRESSOR.—F. E. JENKINS, 121 Kenwood Ave., Medford, Ore. The invention relates to tools for compressing valve springs of automobiles, airplanes, or other gasoline motors; its object is the provision of a device adapted to be engaged upon a valve spring to be compressed and so constructed that after the device is initially set in position it will automatically compress the valve spring.

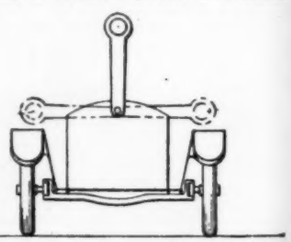
Pertaining to Recreation

PLEASURE RAILWAY.—M. JOHNSON, 249 56th St., Brooklyn, N. Y. Among the objects of the invention is to provide a pleasure railway for parks, exhibition grounds, fairs and other places of amusement, and arranged to accommodate a large number of persons at a time, and to provide an exhilarating ride for the participants. A further object is to provide a pleasure railway which is simple and durable in construction and safe in operation.

TOY.—E. W. TRAUTMAN, Gulfport, Miss. The invention has for its object to provide a device wherein the toy has the outline of a vessel, as, for instance an airplane, torpedo, or ship, and is provided with a supporting pulley adapted to run upon a cord to which the toy is swiveled, the toy having guiding vanes and a propeller, and means for exploding a torpedo when it strikes an obstruction.

Pertaining to Vehicles

DIRECTION INDICATOR.—J. E. MAYHALL, 1216 Madison Ave., Covington, Ky. The primary object of the invention is to provide a convenient means for facilitating driving a vehicle, preferably a motor vehicle in a congested city or in fact anywhere it is desira-



A FRONT VIEW OF VEHICLE WITH DEVICE ATTACHED

ble to give a warning to a vehicle either approaching from the front or rear, the direction which the vehicle or which the indicator is installed is to take, the device being conveniently operated by the chauffeur.

TIRE HOLDER.—A. F. ENGEL, 650 Wayne Ave., Defiance, Ohio. An object of this invention is to provide a tire holder such as is commonly carried on motor vehicles and which permits ready insertion or removal of the tire. A further object is to provide a holder which can be swung to one side to provide a free entrance or exit for the tire, and which when moved into position and locked, will securely hold the tire against accidental movement.

Designs

DESIGN FOR A KNIFE SHARPENER.—T. C. CURLEY, 87 Duane St., New York, N. Y.

DESIGN FOR AN ARTICLE OF MANUFACTURE, NAMELY, A PILLOW OR ARTICLE OF A SIMILAR NATURE.—M. D. DREYFACH, 482 Broome St., New York, N. Y.

The State and the Farmer

(*Continued from page 494*)

details of farm improvement and farm methods have been carried out under the advice of the Board's experts, free to the settlers. Nothing in the community has been done in a loose or haphazard manner and under this *modus operandi* a model farm community was evolved in less than one year.

In the meantime practical farm development was taken up, soil maps consulted, fields, orchards and gardens laid out, and crop production arranged. The Board has made itself the friend and counselor of each settler, and has been unstinting in advice as to the planting of crops, purchase of live stock, tools, equipment, seed, etc. It also gave valuable advice in the organization of coöperative buying and selling organizations among the settlers; the construction of an extensive scheme of roads, drains and irrigation works; as well as advising the farmers as to the best methods of leveling, checking and smoothing their lands and the preparation of seed beds and the planting of seed.

In order that no time be lost in the production of crops the first year the Board helped the farmers by having a big outfit to prepare land for seeding and irrigation and actually to put in crops of barley, oats and wheat, taking the pay for the work out of the crop.

Here are some of the net returns to individual settlers from some of these crops: C. W. Baker, fifteen acres of oats, $105; E. O. Messenger, eighteen acres of barley, $368.28; William Deveney, 20 acres of barley, $66.10; Carl Neilson, eighteen acres barley, $476.75; A. I. Maxwell, 12 acres barley, $313.40; E. E. Will, 47 acres barley, $696.38; Jos. N. Thornton, 54 acres wheat, $624.50; Frank M. Hall, 47 acres barley, $955.15; Roy White, 60 acres barley, $1,390.50.

The survey and mapping of the settlement land were based largely upon the story told by the soil map. Samples of soil were taken at such intervals as was necessary to make an accurate map of the whole area.

With this in hand the sizes of the farms were determined so as to give considerable choice to intending settlers, keeping each farm within such limits that one family, with the help of one farm hand, could take care of it.

Consequently the farms suited to fruit-growing were made small, while the lands suited to farm crops were laid out in larger units, running as high as 160 acres. In some cases a tract of grain land went with a small tract of fruit land, say, 15 or 20 acres, the two tracts sometimes not being contiguous.

The State Land Settlement Board was not insensible to the social needs of the community, consequently it set aside a fine tract of 22 acres as a community center. It is planned to erect upon this plot a community hall where different social and business organizations will find meeting room. There will also be laid out and equipped athletic grounds where the boys may play baseball and the girls lawn tennis. Upon this community center is a fine grove of native oaks where picnics are held. It is also the intention of the board to establish on these grounds a vocational school.

Thus Durham has been made a model rural community. It is benefited not only by the paternal influence of the State but by the fraternal character of the settlement.

The State not only supplies financial backing for the settlers, but it educates them in the most up-to-date farm practices. It has inaugurated both a system of collective buying and of collective selling, thus insuring the settlers against the wiles of sharpers and profiteers.

The settlers themselves become imbued with agricultural ambition and pride. The close intimacy of the settlers begets a common feeling of fraternity.

The concentrated nature of the popu-

lation works for friendliness and sociability, and thus the proverbial dullness of ordinary rural life is done away with and the life of the farmer seems less irksome and burdensome, all of which inures to contentment, happiness and prosperity.

Acting upon the recommendation of Governor Stephens the California Legislature of 1919 appropriated $1,000,000 for continuing the land settlement system, and also authorized a bond issue of $10,000,000 for a like purpose. Under these provisions the State Land Settlement Board has purchased a 10,000-acre tract of farm land in Merced County in the central part of the San Joaquin Valley for settlement in the near future, along similar lines as those governing the Durham settlement. In the settlement of this second tract preference will be given to ex-service men.

Winter Fuel from Our Woodlands

(*Continued from page 495*)

eastern part of the United States, the owners of those woodlands will not cut and market the wood unless they can sell at a profit. Ordinarily, cordwood is sold only in a district within 5 to 10 miles from where cut, and hauling is done directly from the cutting area to the purchaser, but where water or railroad transportation is easily available it is possible for the farmers to cut their wood and ship it several hundred miles at a profit.

Cordwood is ordinarily cut into 4-foot lengths, and with a power saw run by a tractor or gasoline engine, a three-man crew can saw up from 10 to 15 cords per day. Splitting is either done by hand or by machinery, for in recent years several types of splitting saws have been invented and it is possible to saw and split the logs by the same crew.

The cost of hauling wood by team will average from 50 to 75 cents per cord per mile, which restricts the area of delivery to a small radius. When shipped by rail, the freight rate for distances of about 10 miles will average from 50 to 60 cents per cord, while the same wood can be shipped a distance of 100 miles by rail at a cost of from $1 to $1.50 for freight. Water rates are, of course, very much cheaper, and by far the larger portion of the 17,000 cords of wood fuel used annually by the City of Washington is brought up the Potomac River on sailing vessels, carrying an average of 30 cords and requiring but two or three men to operate. In loading or unloading from cars or boats one man can handle from 7 to 10 cords of 4-foot wood per day and from 6 to 8 cords of 16-inch wood.

In attempting to solve the fuel needs of communities, various plans have been devised to bring the producer and consumer together. In a number of cities municipal wood yards have been established, where fuel can be brought for sale. One New England city, which was hard-hit by the fuel shortage two years ago, arranged for the purchase and storage of 100,000 cords of farm wood, to be used as a fuel reserve, and in a Southern State there are more than 30 municipal wood yards in operation. A yard established at Durham, N. C., purchased 1,200 cords of wood at an average cost at the yard of $5 a cord, and was delivered to the consumer at an average cost of $7 per cord. The material was obtained from two sources, one, consisting of slabs, from a sawmill about 14 miles distant, and green pine and oak from farm woodlands near by. The slabs, of odd lengths, were purchased from the mill for $2 per cord f.o.b. cars, and were unloaded at the municipal yard, where they were cut up into desired lengths. The freight charges on these slabs amounted to 75 cents per cord. The wood from the farmers' woodlands was cut in 8-foot lengths and split in halves or quarters. The price was $3.50 per cord piled in the woods. It was hauled from the woods to the roadside by country teams, and motor trucks carried it from the roadside to the yard, and the total cost of hauling was about $1 per cord, for the distance of 3 miles from the cutting area. The cost of cutting the wood into stove lengths at the yard was about 50 cents per cord.

A standard cord of firewood is a pile 8 by 4 by 4 feet, or 128 cubic feet of stacked wood. A pile of green wood will shrink two or three inches through settling and drying, and it is customary to pile green wood somewhat higher than 4 feet to allow for this shrinkage. A running cord, or "face" cord, 8 feet long by 4 feet high and 12, 16 or 24 inches wide, according to the length to which it is cut for use, is frequently called a cord in the market. Though a cord contains 128 cubic feet the space occupied includes air as well as wood, and the actual wood content is only about 70 per cent of this amount, or 90 cubic feet of average size. Small, smooth sticks pile closer together, and therefore there is less wood in a cord of crooked sticks than a cord of straight sticks.

Forewarnings About Forest Fires

(*Continued from page 495*)

Sparks from railroad locomotives which traverse timbered country also cause many destructive forest fires each year. This is displayed by means of a miniature passenger train which runs along the foot of a mountainous slope which is heavily forested. Sparks from the engine fire the underbrush and rapidly the flames climb the hillside. Similarly, fire damages caused by motor tourists who throw lighted cigars, cigarettes or pipe ashes from the automobile as it speeds through a densely timbered territory are also depicted in the mechanical exhibit. These sparks touch off the dry refuse on the ground and directly the flames spread over the adjoining hillsides. From a scientific and mechanical standpoint this novel method of illustrating forest fire causes is extremely meritorious and praiseworthy. Wherever it has been exhibited it has elicited much favorable comment and has resulted in many careless motorists, campers and ranchers reforming their activities as related to camp fire neglect, match use and ignited tobacco disposal.

Solving the Labor Problem—II

(*Continued from page 496*)

through our classes we help the man train for the job ahead. We point out that we fill our big jobs from the inside, and point out the men at the head who started low. What's more we stick by that policy.

After a man has been with us a month, he receives from the Employment Office a questionnaire headed "Application for Promotion." This outlines our policy of filling big jobs from the inside and asks the man what he is doing to prepare himself for promotion. It asks him what he wants to make of himself, and what he is doing to attain that end. When this is filled out and returned we have a fairly good line on the man and are in position to help him help himself.

We have done two things by this: First, we show him that we are interested in his development and look upon him as the sort of man who wants to stick with us. Second, we have gotten a pretty good analysis of the man, his ambitions, and his possibilities. These questionnaires are filed, together with a man's class record, and are consulted when promotions are being considered.

When you combine work of this sort with an absolute policy of square dealing you have a good basis for labor relations. When you realize that the men who work to build your product must be sold on the plant and its policies, just as your customers must be sold on your product and your policies, then you will have progressed a long way on the road to harmony. Men want to be treated as men. They want you to hear what they have to say about the policies under which they

work, and, more than all that, they want to know that you are with them and look upon them as individuals, not accessories to machines.

Now for the pessimism. I always like to include a bit of warning along with the cheerful news.

Don't think that because someone has a plan that works that you can lift that plan and have it work as well for you. It isn't the plan that does it, it's the spirit. Plant spirit cannot be created over night. It does not come as the result of anything but long, hard work on the part of somebody who deliberately lays out a campaign for it.

In our case our campaign of education was running for more than a year before we said anything about any system of employee representation. Our plan came as a factor in a whole campaign to have men understand what they were doing and why. Never has it dominated the situation and we hope it never will.

Your work is never done. Almost every week we have some pamphlet to pass out. We are keeping at it constantly. We believe that the more education a man gets, the more he wants, and we aim to keep him supplied with all the information available on timely subjects.

Remember your workers are the same as you are. They respond to the same treatment that you respond to, and recoil from the same sort of treatment that you would recoil from. Get out in your shops and meet them. Let them meet you. They'll add considerably to your knowledge and you can be of great assistance to them. Tackle this subject together. Tell them what they want to know about the business and let them see the basis under which capital and labor are working in your plant.

Men would rather accept information from you than misinformation from an agitator. The trouble has been that hitherto the agitator has had no competition from those who knew the facts but would not pass them on.

The time has come to change this. Business must sell itself to those who help make it. The workers must be appealed to on the basis of education.

Give your men facts to think with and they'll see the pitfalls in destructive theories.

Fuel or Fertilizer?

(*Continued from page 498*)

legume crops because when introduced into the soil the proper bacteria to suit the conditions become active. Such inoculants form part of the product of these peat plants. A two-pound can is sufficient to inoculate an acre of ground.

The more general practise, however, is to make of the peat a commercial fertilizer and to inoculate this fertilizer with the bacilli before it leaves the plant. Thus is produced a product that is at once a fertilizer and an inoculant and in addition other strains of bacilli are added which generate plant foods from the decaying vegetable matter in the soils. The result is very nearly a "universal" fertilizer, for there is hardly any soil condition or plant growth that cannot be improved by its use.

It is difficult to say how long peat has been used in making manure. A little book published in 1815 by an anonymous author is entitled "Directions for Preparing Manure from Peat." It seems the author was a wealthy Scotch landowner. Having occasion to excavate a small peat bed in building a lake, he was at a loss to know what to do with the muck. His Scotch thrift, no doubt, suggested the idea that it might make a good fertilizer and he began a series of experiments in a truly scientific spirit. After several years he decided that the best manure was made by mixing common stable manure with about double the quantity of peat, and letting it stand, mixing occasionally. He found that the decay in the peat was apparently communicated to the

manure and that he very quickly had a product which gave results superior to the manure alone.

It is rather curious to note that although the Scotch landlord's advice was apparently forgotten, the same method is recommended to farmers by agricultural experts today. Hundreds of farmers have a supply of such fertilizer available but have made no use of it.

Indeed, a peat bog is often the most valuable part of a farmer's acreage, but it is a common sight to see land cultivated up to the edge of a swamp and the swamp itself neglected. In spite of the fact that our peat resources are almost untouched, the bogs are already producing most of our commercial crops of celery and onions and a large part of such crops as carrots, lettuce, cabbage, horseradish, peppermint and cranberries.

The methods used at a peat plant at Alphano, N. J., one of the largest in the country, illustrate modern methods of production. The bog here consists of about 1,500 acres and the deposit varies from two to twenty feet in depth. The land was a marsh until reclaimed by a drainage system.

The first step in the process is to till the land. Great crops of celery are raised here every year. The plowing and disking of the soil in farming it sun dries the surface and cultivation during the season kills off the weeds so that there will be no weed-seeds in the finished product, while lime is added to "sweeten" the soil. At the end of the season about three inches of the top soil, which is then dried to a moisture content of about 65 per cent, is scraped off and piled in great storage heaps near the plant.

The soil scraped off is then replaced by a specially designed machine which digs up peat with a chain bucket, shreds it, and then scatters it by means of a powerful blower. Thus after each crop the area of the bog is cut down a little by slicing away the sides to cover the top. This machine is shown on the cover of the present issue.

The peat goes through a general conditioning process in the storage piles and the bacteria are added to it here. When the peat is taken into the plant it is first passed through a set of spiral knives, operating like a lawn mower blade, which reduces the peat to a very fine granular form. The potash and other chemicals are added in a mixing machine and the peat goes through a final process of drying in huge mechanical dryers. Great care is taken not to overheat the mixture so that the bacteria are not injured.

This final drying has a double purpose. By reducing the moisture content a considerable saving in freight is effected in shipping the product in bags, and the peat is rendered more absorbent. Fertilizer is often applied with the grain drill along with the seed at the time of planting. A fertilizer for this purpose must be finely pulverized and must flow freely. The peat has the ability to absorb so much more moisture than the atmosphere can possibly give that it does not become soggy. Once the fertilizer is in the ground this absorbent quality causes it to act as a sponge in absorbing and holding water and it is a protection against drying out the land.

Part of the peat, which is sold to other manufacturers of fertilizer, is dried out very thoroughly before leaving the plant and it does not undergo the conditioning processes.

The growing popularity of peat fertilizer in the last few years has been largely due to the fact that many nitrates, which had hitherto been available for fertilizer, were used in making explosives for our army and navy. Most of the ammonia formerly used in fertilizer, the scarcest and most expensive of the ingredients, used to come from the tankage or waste of the great packing houses. But ammonia has advanced in price so that it is no longer profitable to use it for fertilizer.

Peat has its own natural supply of ammonia and because it is put there by nature it is distributed more perfectly than could be done by the best of mixing machines. Peat fertilizer has the advantage over chemical fertilizers that all of the chemicals are not immediately soluble. About one-third of them are at once available as plant food but the rest are released only through decay and the activity of the bacteria. The fertilizer hence remains effective for about five years after it is applied.

The new-born industry has been greatly aided by the American Peat Society, organized in 1907. The society now has some 300 members, with offices at 17 Battery Place, New York City. Its officers serve without pay. The society publishes a quarterly journal which includes original papers of practical experience, abstracts from contemporary literature and patents, and descriptions of the latest uses for peat, etc.

Although certain parts of Europe have used peat for fuel for many years, due to a lack of coal deposits, the annual consumption there now totaling about 10,000,000 tons, it is only recently that European peat manufacturers have recognized a common interest and have begun organization. The "Union des Tourbiers de France" has just been organized in Paris.

Because of this world-wide reawakening in the industry itself, as well as the widening scope of usefulness for the product and the great advancement in the science, we may expect to hear more and more of peat in the years ahead.

Gas-Tubing Tests

(*Continued from page 499*)

(G) An all-metal end-piece screwed into the tubing: a very satisfactory connection where it is not necessary to connect and disconnect frequently. In attaching to an appliance care must be taken not to get the threads crossed.

(H) Tubing is glued into rubber end-piece directly. The strength of this type of attachment is usually small and leaks are very frequent with it.

(I) Metal tail-piece is screwed into end of tube and is held in rubber end-piece by corrugations which fit corresponding corrugations in the rubber. This is usually a satisfactory method of attachment.

"Tennessee"—Our Latest Battleship

(*Continued from page 501*)

The "Tennessee" and "California" are the last ships that we shall build carrying the 14-inch gun. The next class, consisting of four vessels, the "Colorado," "Maryland," "Washington" and "West Virginia," will be about 1,000 tons larger than the "Tennessee"; but otherwise, so far as general appearance is concerned, will resemble her. The principal difference will be that eight 16-inch guns will take the place of twelve 14-inch guns, and that a great weight of protective armor will be employed.

First Aid for Inventors

(*Continued from page 502*)

tions of the committee provide that it shall investigate "any subject referred to it by the institute or by any of its sections," or, by a majority vote of the members present at any stated meeting, it may investigate any subject presented on motion of a member or by application. The method of procedure for the unknown inventor to enlist the services of the committee is to write to Dr. R. B. Owens, Secretary of the Institute, stating what he has to offer and requesting an application blank. This is issued when the Secretary, through correspondence, is convinced that the appliance or process has merit.

The application blank contains the following questions which must be answered:

1. What is the specific purpose of this invention?
2. What is the condition of the prior art in this regard?

3. What improvement is claimed to be effected by the invention?
4. How is the improvement effected?
5. What patents, if any, have been issued for this invention?
6. What citations, if any, were made in this regard by the Patent Office before allowance of patent claims?
7. Is the invention now in actual use?
8. If so, since when?
9. Where may it be seen in operation?
10. Are you prepared to submit drawings of the apparatus or device?
11. Are you prepared to submit a model of the apparatus or device?
12. If the invention is a composition of matter, are you prepared to submit specimens of the ingredients and of the compound sufficient for the purpose of experiments?
13. If the invention is a chemical process, are you prepared to give a demonstration of the same?

It is required also that the applicant submit two copies of each of the United States patents issued to him, with the answers to the above. He should send in also whatever additional information may be called for by the nature of the discovery.

The application is first referred to a sub-committee on new subjects and preliminary examination, which recommends to the general committee acceptance or rejection. This sub-committee and the general body hold formal meetings once a month, but this does not begin to indicate the vast amount of free time devoted to inventions. Regular meetings are held mainly for the purpose of coördinating the reports of investigation and experiment on the matters under consideration. When this sub-committee recommends an investigation a special sub-committee is appointed to conduct it. As a rule the sixty members of the general committee comprise experts in every line of mechanical and scientific work, but the institute has provided that wherever necessary the Science and Arts Committee may include in the investigating body "a minority of other persons whose expert services are desired in the examination."

There are other regulations for the protection not only of the institute, but of the applicant as well. One provides that "no person shall be a member of a sub-committee on investigation who is interested in the issue." Other regulations containing information that may be of value to inventors who may plan to make application to the institute are as follows:

"Sub-committees shall whenever possible make direct examination and tests of the subject under investigation, and shall not accept tests, data, or information furnished by others without first satisfying themselves as to the accuracy thereof. They shall in no case recommend an award solely on the basis of tests, data or other information furnished by parties in any way interested in the subject of the award. Sub-committee must ascertain that articles, processes, products, etc., examined are genuine samples of the subject under investigation."

The sub-committee may recommend award of the Cresson medal, the Howard N. Potts medal, the Edward Longstreth Medal of Merit, or the Certificate of Merit. These are awarded for the following reasons:

The Elliott Cresson Medal: For discovery or original research, adding to the sum of human knowledge, irrespective of commercial value; leading and practical utilizations of discovery; and invention, methods or products embodying substantial elements of leadership in their respective classes, or unusual skill or perfection in workmanship.

The Howard N. Potts Medal: For distinguished work in science or the arts; important developments of previous basic discoveries; inventions or products of superior excellence or utilizing important principles; and for papers of especial merit that have been presented to the institute and published in its journal.

Edward Longstreth Medal of Merit (with a money premium when the accumulated interest of the fund permits): For meritorious work in science or the arts, including papers relating to such subjects originally read before the institute, and papers presented to the institute and published in its journal.

Certificate of Merit: To persons adjudged worthy thereof for their inventions, discoveries or productions.

The Committee on New Subjects and Preliminary Examination for this year consists of seven members of the general committee and is typical of the wide variety of interests represented in the membership of the Franklin Institute. The chairman is Dr. H. J. M. Creighton, assistant professor of chmeistry at Swarthmore College. Other members are Charles E. Bonine, practicing electrical engineer; Nathan Hayward, president of the American Dredging Company and a consultant for the Bell Telephone Company; Lionel F. Levy, manufacturer of fine screens for half-tones; Charles W. Masland, manufacturer of carpets and textile expert; M. M. Price, chief engineer for the Babcock and Wilcox Company, and James S. Rogers, an attorney.

There is hardly a member of the general committee whose record does not require considerable space in "Who's Who," and all are known in scientific or technical lines. One man, Hugo Bilgram, has been a member of this committee continuously since 1873. His hobby is mathematics, and he is nationally known as a manufacturer of gear teeth and precision machinery. A few others of note are Dr. James Barnes, professor of physics at Bryn Mawr College; W. C. L. Eglin, vice-president and chief engineer of the Philadelphia Electric Company; Dr. A. W. Goodspeed, professor of physics at the University of Pennsylvania, and Dr. Gaetano Lanza, emeritus professor of mechanical engineering at the Massachusetts Institute of Technology and now consultant to the Baldwin Locomotive Works.

Direct service is given by the institute to young men of a mechanical or scientific turn of mind through its classes in mechanical drawing, architectural drawing and design, freehand drawing and water color, shop arithmetic and algebra, plane geometry and trigonometry, applied mechanics and machine design, and theoretical and practical naval architecture.

What About Our Wheat Production?

CONSIDER the physical character of alfalfa! It is hardy and most prolific. Given deep and mellow seed beds, and the proper amount of moisture, it will produce most prodigiously. It is one of those legumes which are capable of absorbing the free nitrogen of the surrounding atmosphere, and of depositing this important chemical in its roots and branches, the former being provided with multitudes of nodules for the storing of the nitrogen. Mechanically no known plant is better adapted to the tilth and fertility of the soil in which it takes root.

Alfalfa is not only a profuse but a deep rooter. In certain instances alfalfa roots have been known to penetrate the earth to a depth of thirteen feet or more. It is a bushy plant, with vigorous, fibrous stalks and branches and a luxuriant leafage. So when it comes to plowing in the last growth of a season we have, from above ground, a mass of plant growth, and from below a deep and intricate network of rootage. All of this vegetable matter is turned under by the plow, decays and imparts to the soil that vital element known as humus, or vegetable matter in process of decomposition.

And we find the root material nicely distributed for the purposes of fertilization; and the soil, after the decay of this mass of rootage, honey-combed by myriad little root tunnels, a condition that renders the soil mellow and most susceptible to proper aeration, and absorption of moisture.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries; do not telephone them, please.

(14352) L. M. A. asks how to separate gold and platinum. A. Usually where there is gold and platinum there is also silver in the alloy. To separate them, be they in filings or pieces, reduce them like gold with aqua regia, in a porcelain dish; cover with a glass funnel; set in a chimney or where the fumes can escape on hot sand, until the metal is all dissolved. Let it remain in the warm sand bath until the liquid has evaporated to the consistency of syrup, and then let cool. Pour on enough muriatic acid to well cover the syrupy mass, cover again with the funnel, and let evaporate on the sand bath again till a syrupy mass results. To every gram of metal five grams of water are added to the mass, well mixed and boiled for half an hour. Let it get cold, then filter through a close filter paper and a glass funnel, and the particles remaining in the filter paper are silver. The silver on the filter paper can be melted in the usual way. The above filtered solution is now treated for platinum. In a pint of boiling water put 200 grams of powdered sal ammoniac and let dissolve; then mix this with above solution, stirring well with a glass rod. Let stand for two or three hours to settle. The platinum gathers in an orange-like mass at the bottom which is the chloride. Filter off the top carefully without disturbing the yellow very much. The yellow mass is mixed with about 300 grams of water, well stirred. Keep on stirring and filter through the already used filter. Let drip out well and the precipitate on the filter is platinum. Let this dry for 24 hours, place in a crucible, pressing the filter paper in well so it will serve as a cover. Heat gradually until no more smoke rises and a white-red heat is obtained. Let cool, then melt again and run into an ingot or button.

(14353) R. F. N. asks how to clean tarnished gold after hard soldering. A. Before attempting to solder gold, paint over with a paste made by mixing yellow ochre ground up with water and a small quantity of borax. This paint will somewhat protect the surface from oxidation. After soldering, the gold should be placed in a pickle composed of nine parts water and sulphuric acid 1½ parts. It is best to throw the gold in the pickle while still hot from the soldering. Very often the soldered and pickled gold will show whitish in streaks, caused by the silver in the alloy. If so, dip for moment in a hot pickle solution of sulphuric acid and saltpeter, then dip in cold water, wash clean and proceed to polish, first with rotten stone and oil. Wash again and finish polishing with rouge.

(14354) H. W. J. asks: I am a constant reader of your magazine and would greatly appreciate information through your columns concerning the behavior of lines of magnetic force, preferably lines around a permanent magnet. The specific information is to know if it is possible to "insulate" to any extent a permanent magnet so that the lines of force will not attract steel or iron. In other words is there any substance, solid, liquid or gas which can be placed between a magnet and its armature or attracted object so that that attraction is no longer felt by the object or witnessed by an observer? If there is no such substance, why not? or is it an impossible thing and oblige. A. Lines of magnetic force cannot be confined in a space as the electric current can be by insulation. The only way in which they can be prevented from entering a space is by furnishing them with an easier path around that space. Iron furnishes such a path, since its permeability is greater than air or any other substance. A magnet is protected, insulated, if placed in a box of rather thick iron, perhaps a half inch plate.

(14355) R. M. S. asks: Please be so kind as to give us information in regard to light and heat from the sun direct. It is taught in our schools that we receive light and heat directly from the sun, as we do from a bonfire, as we stand near it at night. On the other hand some scientists say not so. That in all those 95 millions of miles it is intensely cold and dark and therefore impossible for light or heat to pass through. So in our schools and colleges are they teaching a lie? If you will kindly answer this it will be greatly appreciated by a number of us inquisitive ones who wish to know. A. The rays of the sun as they pass through space are neither haet nor light. They are capable of becoming heat if they strike anything which can be heated, your hand, for instance, or they will become light if they strike an eye which can transform them into light. The heat from a bonfire heats the air because the air can receive it, but it will not heat a vacuum where there is no air. Space, empty space, we often call it, but it is not quite correct to call it empty, is not heated by the rays of the sun. The air itself at high altitudes is not heated very much by the sun's rays as they come down through it as is seen by those who find it extremely cold upon going up in airplanes or balloons. The powerful rays of the sun lose very little of their energy in passing through space because there is very little there to intercept them. They lose some more in our upper air but still have great power left which they give the earth at its surface, enough to produce the growth and life which we see.

(14356) R. L. W. asks how to refine commercial gold. A. If one desires to obtain pure gold from gold of inferior qualities the scraps should be treated in the following manner: To one ounce of mixed qualities of gold add two ounces of fine silver. Place the material in a plumbago crucible and melt in a good furnace, a little powdered charcoal being added to protect the fusing mass from the action of the air, which would otherwise cause a scum to appear on the surface. When the mixture is thoroughly melted it must be formed into a deep vessel of cold water kept well stirred in a circular direction during the operation; this will cause the fused alloy to break up into small fragments; or the fused alloy may be poured into a hot ingot mold and afterward rolled down into thin sheet metal and cut up into pieces sufficiently small to enter the mouth of the dissolving flask. The object in doing this is to present as large a surface as possible to the action of the acid which is employed to dissolve the metal. The small particles of metal are carefully collected together and placed in a glass dissolving flask, and to each ounce of the alloy two ounces of pure nitric acid and two ounces of water are added. The flask is then placed on a sand-bath and gentle heat applied until all the metals—with the exception of the gold—are dissolved into the liquid; the gold remains undissolved at the bottom of the flask, in a finely divided form of pure metallic gold. It will thus be seen that the acid mixture dissolves the silver and copper but not the gold. The brown powder of metallic gold is then washed well with either hot or cold water and the washing added to the first solution which was poured away from the gold in the flask. The gold is next dried and melted in a clay crucible under a small quantity of dried common salt, and should then be quite free from base alloy. If the gold is required for making a gilding solution, it may be taken in the powdery state, direct from the washing operation, and dissolved in aqua regia, and subsequently converted into chloride of gold. It may be advisable to obtain absolutely pure gold to add a little fresh acid to the gold powder before removing it from the flask, to make sure that all the silver and copper have been removed. Heat must be applied as before to cause full chemical action. The silver and copper will be in the fluid poured from the dissolving flask in the form of nitrate of silver and nitrate of copper, and should be preserved with the view of recovering the silver.

(14357) C. F. D. asks: As farm lighting plants generally are of 32 volt potential am I right in concluding that that is as high as permissible? What is the highest voltage direct current that is considered safe for children and other people to handle? A. Farm lighting plants are generally run so that the dynamo is not run all the time, but charges a storage battery and this supplies the lamps in the evening when it is not convenient to run the dynamo, if run by water, or impossible to run it, when it is calm, if run by a windmill. The cost of a storage battery is so large that the voltage of the lamps and other machines is kept as low as can be, so that the number of cells in the battery may be as small as can be. The usual voltage of an incandescent lighting circuit is 115, and this is quite safe. It might be that a peculiarly susceptible person would be injured by a shock from it, but ordinary people only feel it as a needle or pin prick. 300 to 500 is the limit of low voltages. Above 500 the shock is severe.

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